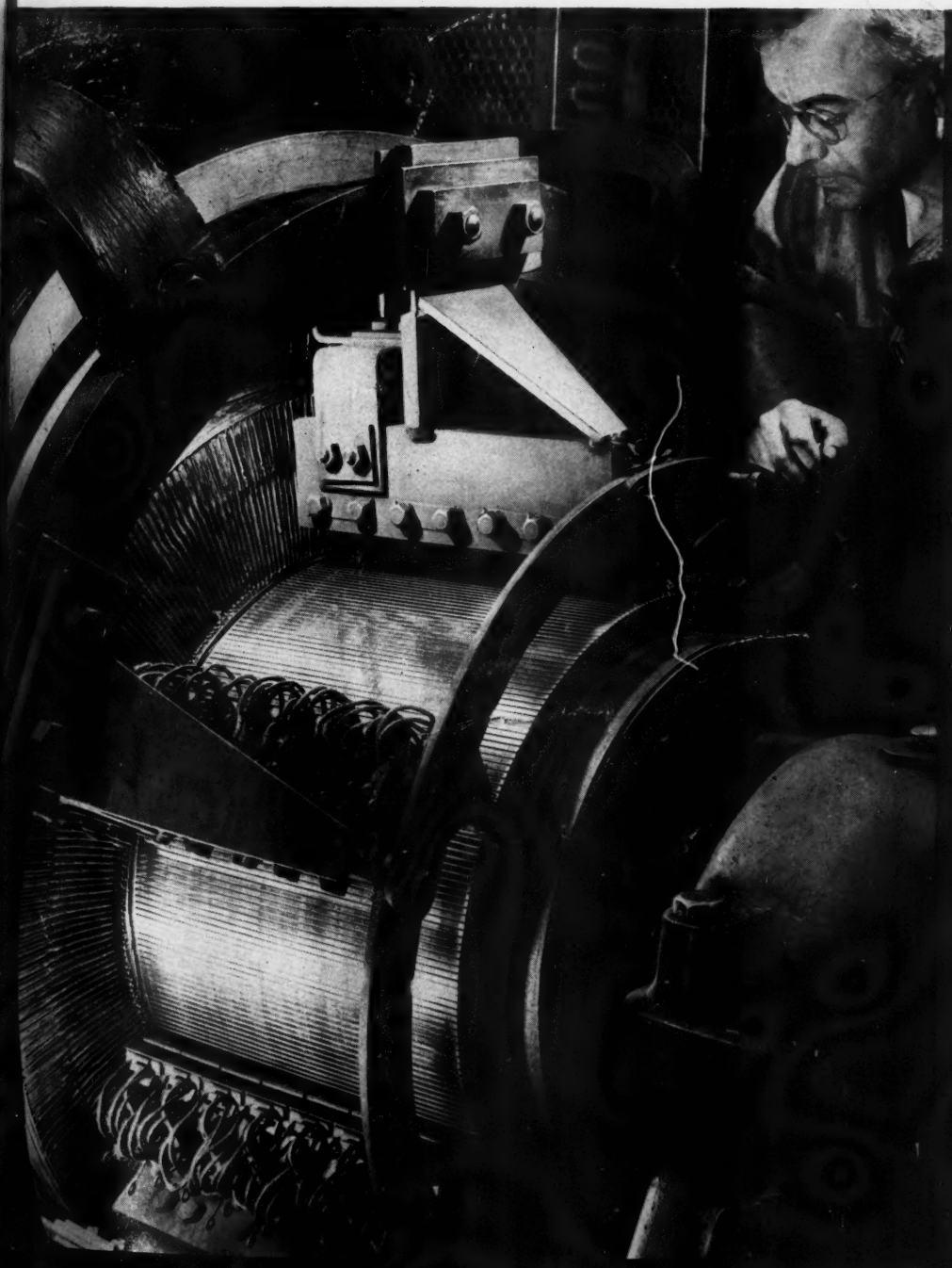
Electrical Contracting

THE MAGAZINE OF ELECTRICAL CONSTRUCTION & MAINTENANCE



IN THIS ISSUE two and three phase distribution . . . wiring by long term layout plan . . . treated brushes . . . standard symbols . . . three lighting plans for a store . . . figuring bus systems by zones . . . practical methods and useful data for shop and job.

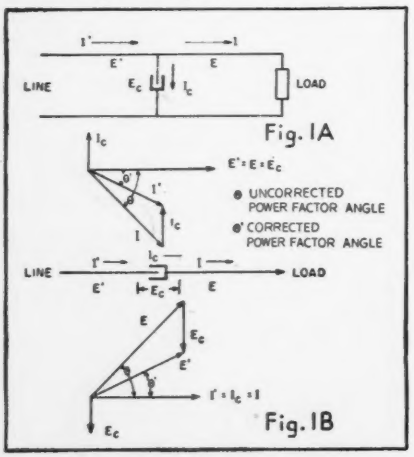
DECEMBER 1946

NO. 4

Helpful Hints on Applying Capacitors

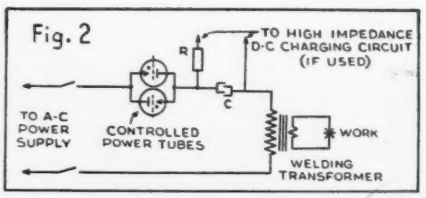
The Use of Series Capacitors for Industrial Circuits

Capacitors installed for power-factor improvement are normally connected in shunt with the load or system, providing an out-of-phase component of *current* to supply reactive kva. (See Fig. 1A.) In certain applications, however, capacitors perform another valuable function when connected *in series.* (See Fig. 1B.) Used this way, they provide an out-of-phase voltage component which has the effect of evening out voltage level under rapid intermittent loads. This is commonly known as "stiffening" the system.



DUAL-PURPOSE APPLICATIONS

In applications of series capacitors to "stiffen the system" for motor starting and the like, the capacitor kva is not high enough to raise the power factor significantly. In other cases, as on resistance-welding applications, for example, one of the functions of the series capacitor is to effectively furnish power-factor correction by compensating for the welder reactance. A shunt-connected capacitor is undesirable in this application because its output is constant and does not follow the load. The series capacitor, however, allows the feeder to handle more or larger resistance welding load.

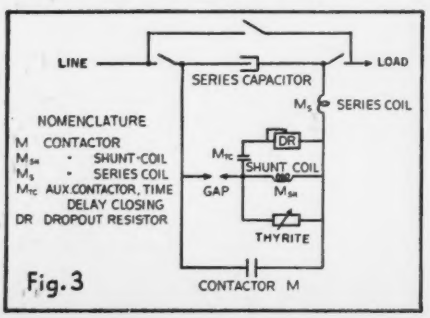


METHODS OF APPLYING SERIES CAPACITORS

When series capacitors are to be applied to resistance-welding circuits, their capacity and the circuit connections must be matched to the system of control (see Fig. 2). The following information is necessary to calculate capacity.

1. Kilovolt-amperes (volts × amperes ÷ 1000) and power factor (watts ÷ volts × amperes) under maximum working conditions.
2. Kilovolt-amperes and power factor with the electrodes directly short circuited, in order to determine maximum current and the protective requirements.
3. Line voltage and frequency.
4. Type of control, that is, mechanical contactor, synchronous or non-synchronous electronic control.
5. Duty cycle (cycles on, cycles off, pulsation per weld, and welds per minute).

The calculations required are made easy by the use of curve sheets* available for various supply voltages.

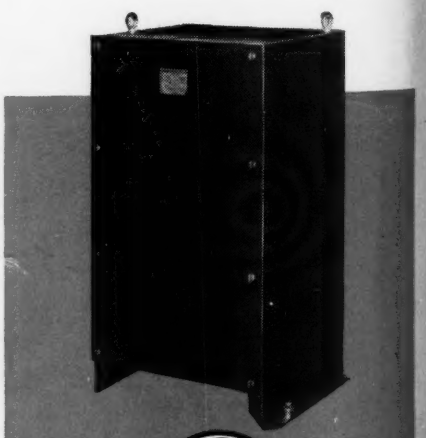


PROTECTIVE CIRCUITS FOR SERIES CAPACITORS

As the voltage across the series capacitor is a function of circuit current, it may be dangerously high for the dielectric under short-circuit fault conditions. A protective circuit may be desirable to by-pass such overloads, automatically reinserting the capacitor in the circuit when the fault current decreases to a predetermined value. See Fig. 3.

Whatever your problem in correcting power factor, eliminating light flicker or other function for which capacitors offer a remedy, G-E application engineers will be glad to work with you in selecting and applying them. Just call your local G-E representative. ***Apparatus Department, General Electric Company, Schenectady 5, N. Y.***

* Application of Series Capacitors to Resistance-welding Machines, reprinted from *Welding Journal,* Jan. 1943, GET-1134.



PYRANOL CAPACITORS

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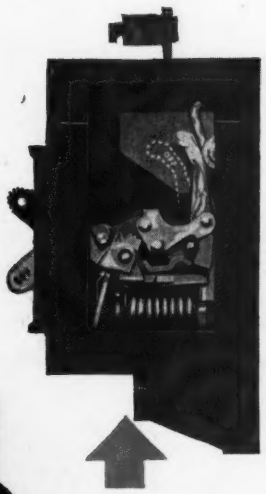
NOW *in production*—Murray MAGNETIC CIRCUIT BREAKERS

IN NEW APPLICATIONS



THESE much-wanted, new applications are shown below. The heart of each is the Murray MAGNETIC Circuit Breaker—magnetic, because, by means of magnetism alone and without thermal action of any kind, it provides absolutely instantaneous shut-off of current in the event of a short circuit and delayed interruption in the case of overloads. These compact, underwriter-approved Murray Magnetic Circuit Breakers are ready for shipment NOW. Write or 'phone your nearest jobber for all the facts, or ask us direct. Metropolitan Device Corporation, Brooklyn 16, New York.

ABOVE

The use of a magnetic tripping mechanism and an efficient magnetic blow-out provides an instantaneous circuit interruption in the event of a short circuit. A precision time-delay device accommodates the brief overloads normally encountered, such as motor-starting currents or the high initial current flow through tungsten lamps. The characteristics of the Murray Magnetic Circuit Breaker are not affected by above-normal temperatures ordinarily found in service equipment.

ABOVE

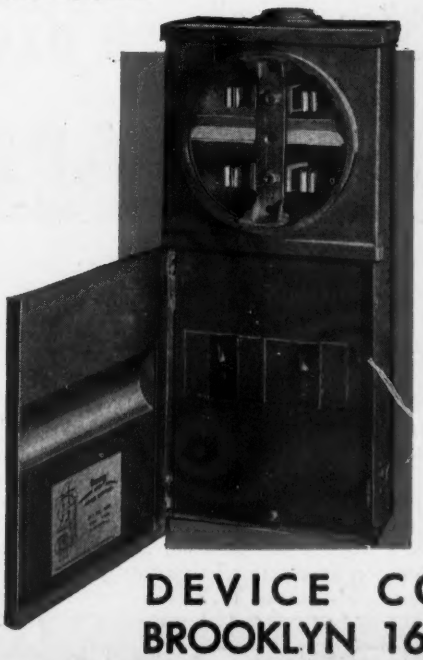
Outdoor, weather-proof, deep-drawn service equipment, supplied with one or two circuit breakers. Has a 1¼" formed hub in top end-wall.

CENTER

Outdoor combination socket-meter and load center, equipped with two circuit breakers and bussing necessary for addition of four breakers. Rust-resisting metal, aluminum finish.

RIGHT

Load centers, supplied with two or more circuit breakers. Are equipped with busses and connectors for a total of six circuit breakers. Indoor-flush and surface types — with baked-on aluminum finish.



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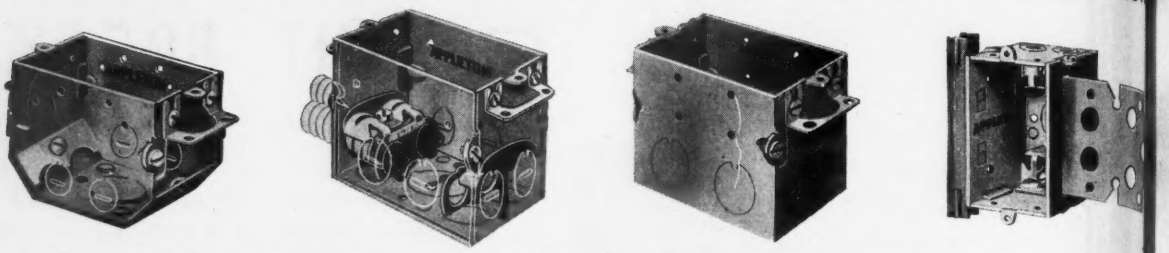

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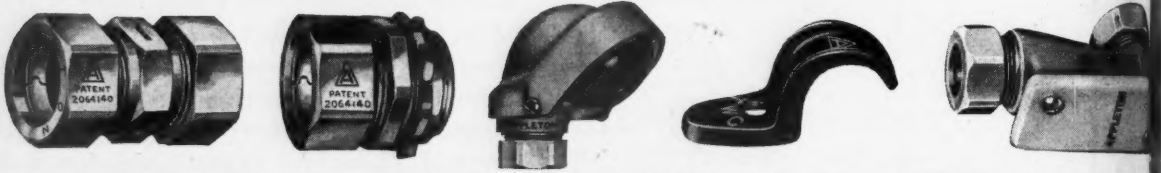

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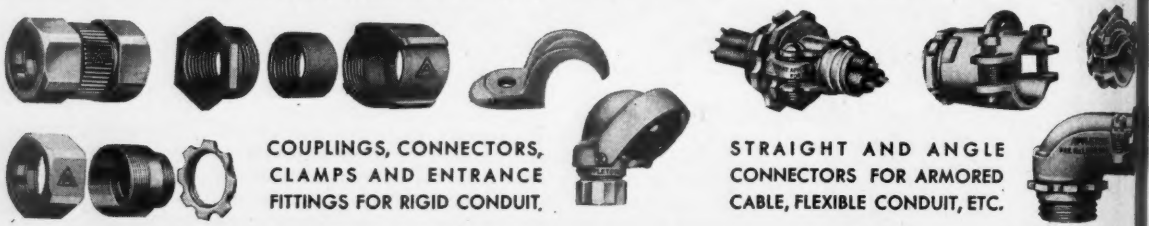

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Electrical Contracting

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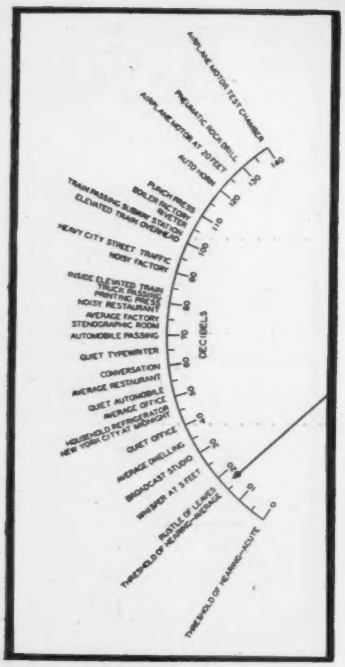
MORE QUIET than the RUSTLE of LEAVES



The decibel scale shows relative noise values. NOTE the impressive rating of the average Acme Electric fluorescent lamp ballast!

Decibel scale reproduced from the "Noise Primer" through courtesy of General Radio Company, Cambridge Massachusetts.

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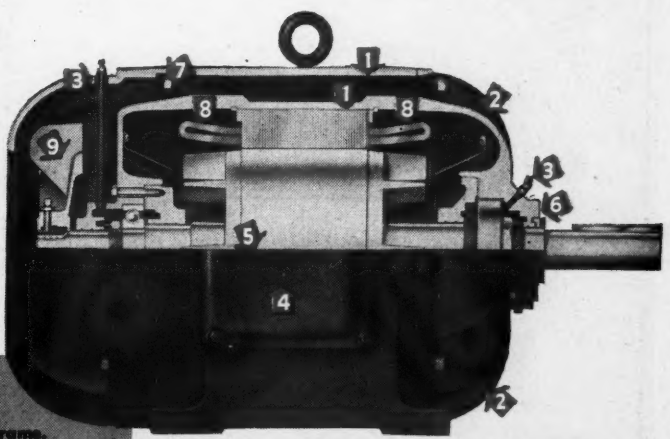

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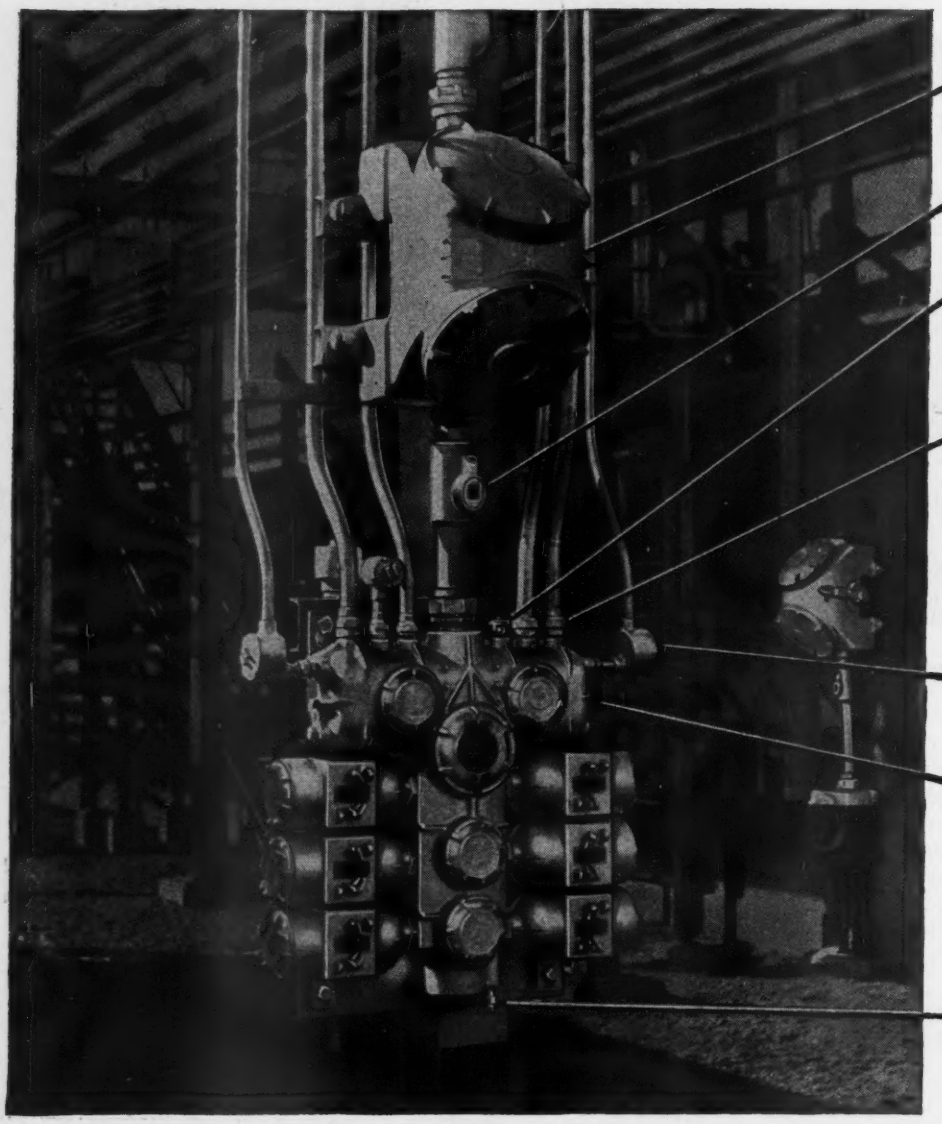
Type FLB Explosion-Proof Circuit Breaker Condulet protecting the main lighting feeder
Type EYS Sealing Condulet
Type ECD Breather Valve and Type ECD Drain (shown at bottom of panelboard) ventilate and drain the main wiring compartment
Type UNY Explosion-Proof Union
Type GUAB Explosion-Proof Junction Condulet
Type EDP Explosion-Proof 12-Circuit Lighting Panelboard
Type ECD Drain

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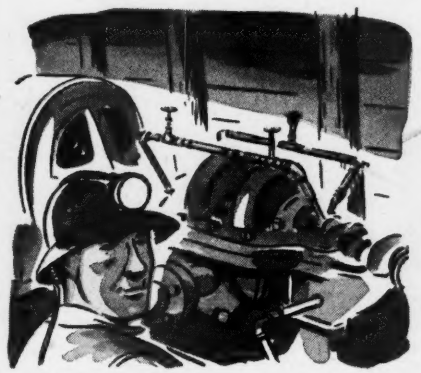
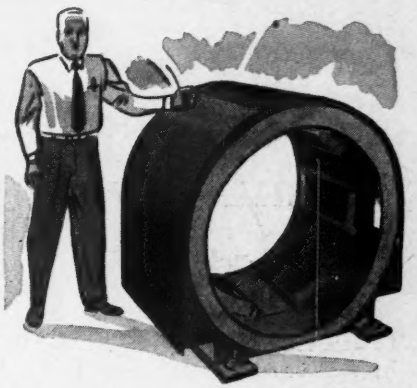
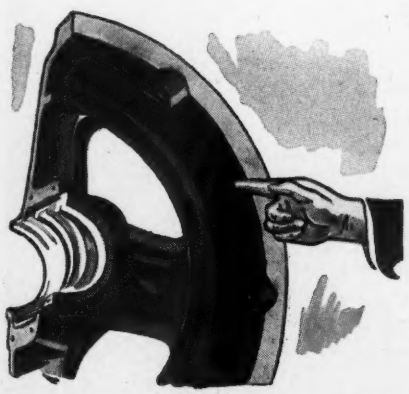


Which Is Another Way of saying they *stand up better* than any other make we've used on this job!" Strong words, but they describe exactly how this customer feels about the 500-hp, open type, bracket bearing Allis-Chalmers motors he started using back in '35.

Since Then He's Ordered 14 *identical* motors for mine pump service! Yes, in almost every industry you'll find these 250 hp and up, medium and high-speed motors paying their way on toughest drives. A check into several of their unusual features will reveal *why*.



Take Yokes, for example. *Steel,* not cast iron. Result: they've got more strength, feet won't break off, there are no projections inside or out to catch dirt. Furthermore, yokes are solid . . . have no openings to admit dust or dirt during non-operating periods.



And Bearing Brackets are *extra*-deep . . . giving greater protection to stator winding coil ends. They're oil leak-proof too. Further, these motors are quiet in operation. Liberal air paths keep air velocities low. Enclosed type yokes reduce noise. Magnetic noise is kept to a minimum. *Yes, from every angle, A-C builds quality into motors!*

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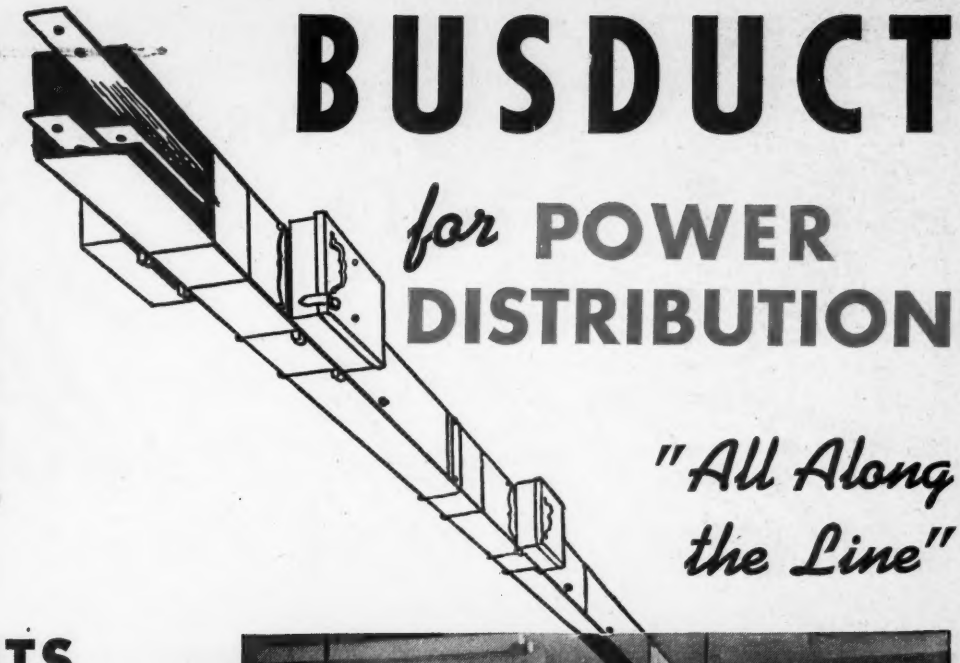

"All Along the Line"

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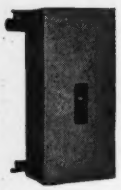
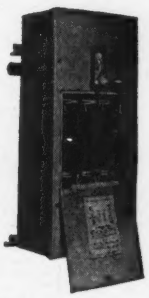


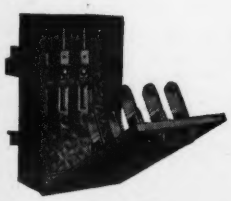
CIRCUIT BREAKER

This Plugin Unit provides automatic thermal protection for circuits and equipment. Capacities: 15-225 amps., 250 and 575 volts.



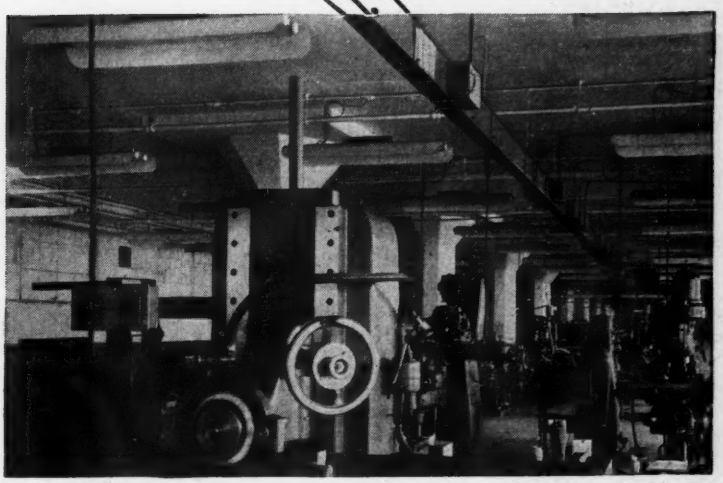
SHUTLBRAK

A quick make-and-break, heavy-duty operating switch . . . excellent for frequent operation. Capacities: 30-200 amps., 250 and 575 volts.



KLAMPSWITCHFUZ

Excellent for disconnect service . . . the hinged-type pull out door contains *both* switch and fuse in one unit. Capacities: 30-200 amps., 250 and 575 volts.



If you are looking for an efficient yet economical way to increase the productive capacity of your plant, then consider FA BUSDUCT — the modern method of power and light distribution.

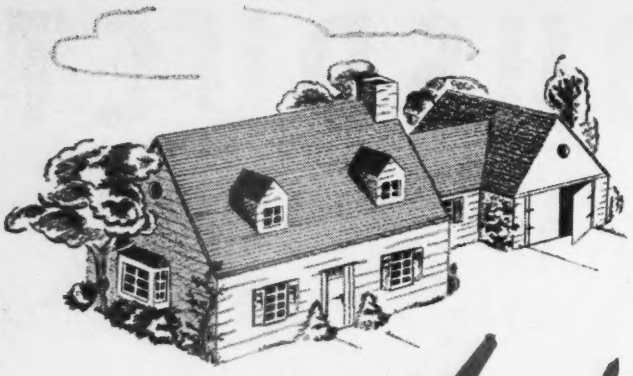
Combining high efficiency with greatly increased flexibility and economy, FA PLUGIN BUSDUCT makes power available *where* and *when* you need it. It reduces to a minimum the costly delays of moving and relocating machinery, and eliminates long expensive lead-ins with a consequent fluctuation in voltage.

FA PLUGIN BUSDUCT provides all the capacity needed for large and small machinery. Made in standard 10-foot sections with multiple outlets for either Circuit Breaker, Shutlbrak or Klampswitchfuz Plugin Units, FA PLUGIN BUSDUCT is easy to install and economical to operate. Designed for 2, 3 and 4 wire systems, 250-1000 amp. capacities for 575 volts AC or less.

For full details consult your nearest FA representative.

Frank Adam Electric Co.

ST. LOUIS, MISSOURI



FOR RESIDENTIAL WIRING

The Modern Way is

Besides eliminating thread-cutting, there is no need for turning a long line of raceway when you use Republic ELECTRUNITE E.M.T. Just slip a simple compression-type coupling between the two lengths of tubing and tighten with wrench or pliers. That's all there is to it . . . every joint is strong, water-tight, good for the life of the installation.

12 Advantages

1. FULL PROTECTION
2. NO THREAD-CUTTING
3. INCH-MARKING
4. LIGHT WEIGHT
5. EASY TO BEND AND REBEND
6. STANDARD FITTINGS
7. EASY TO INSTALL
8. UNBROKEN CORROSION-RESISTANCE
9. KNURLED INSIDE SURFACE
10. UNIVERSAL ACCEPTANCE
11. LOW COST
12. WIDESPREAD DISTRIBUTION

the Electrunite Way

ELECTRUNITE E. M. T.—THE *ORIGINAL* LIGHTWEIGHT RIGID RACEWAY—KEEPS INSTALLATION COSTS DOWN . . . PROVIDES SAFE, POSITIVE WIRING PROTECTION

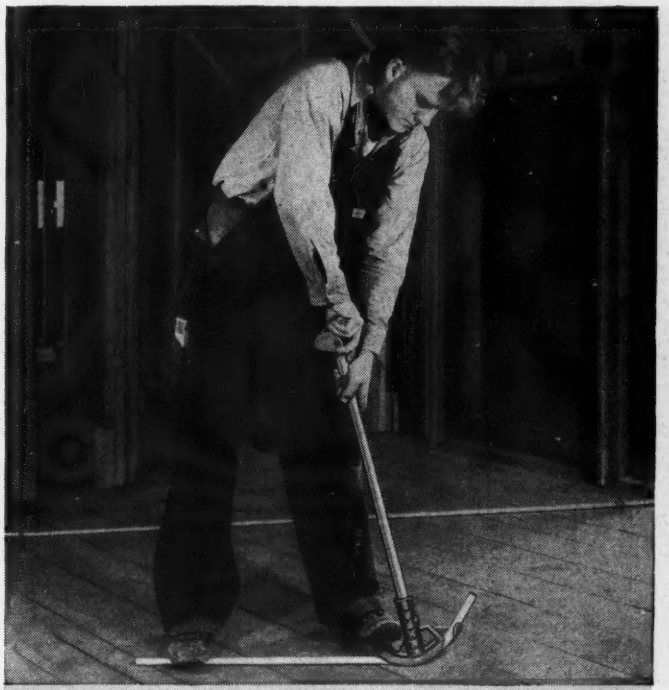
There's positive, lasting safety in wiring that's protected by tough, strong Republic ELECTRUNITE E.M.T.—the modern *streamlined* wiring raceway. It puts an *up-to-date* wiring system—adequate for immediate needs plus margin for tomorrow's requirements—within the range of every home builder.

An ELECTRUNITE E.M.T. installation is low in cost because it goes in quickly, efficiently and economically. Modern *threadless* couplings and box connectors eliminate completely the muss, fuss and bother of old-fashioned thread cutting.

Remember that Republic ELECTRUNITE E.M.T. is the *original* lightweight rigid steel raceway . . . inspected by Underwriters' Laboratories . . . and approved by the National Electrical Code for exposed, concealed and concrete slab construction.

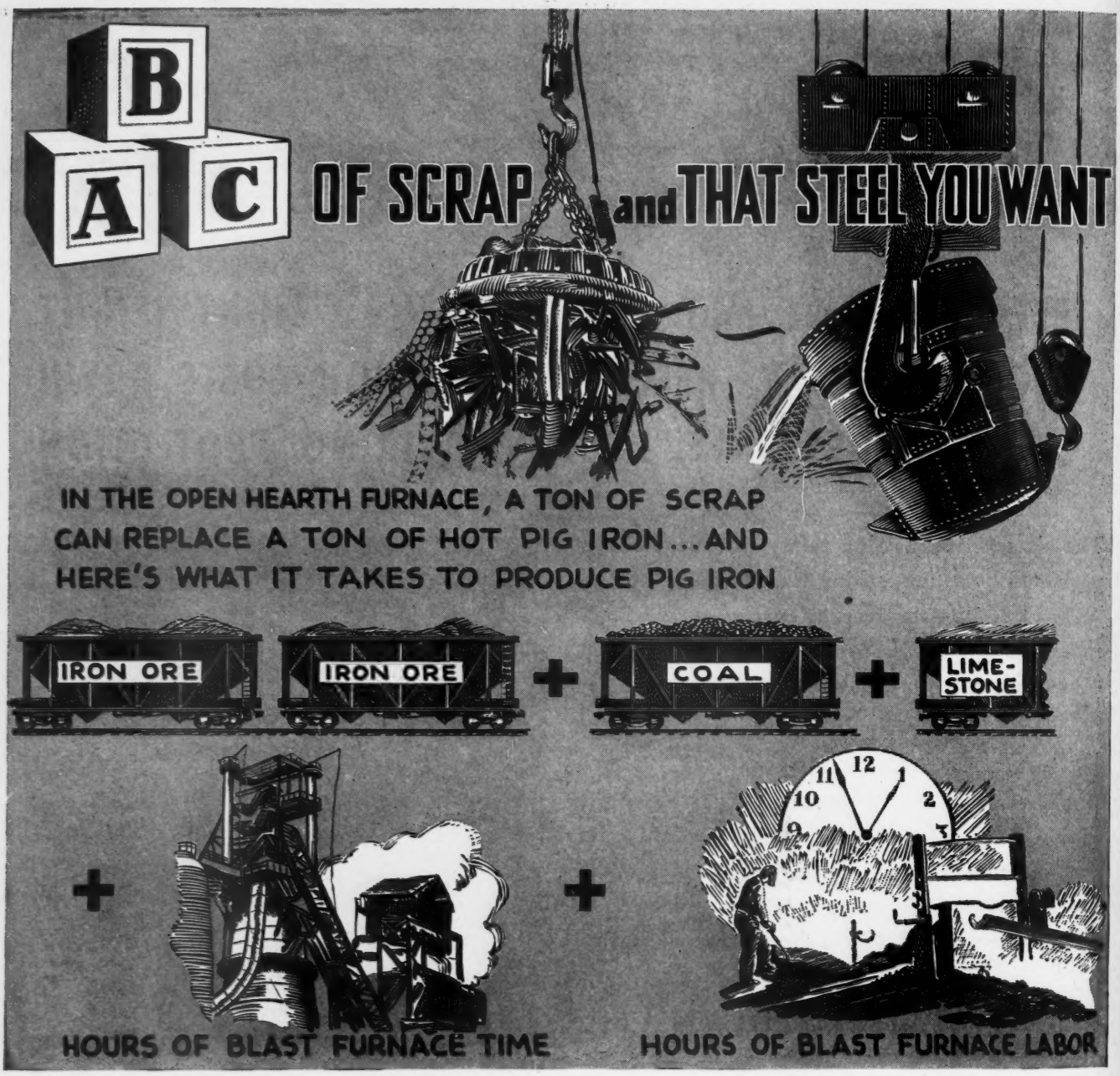
For complete details, see your nearest ELECTRUNITE Distributor.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, N.Y.



With the ELECTRUNITE Bender, standard radius bends of all types can be made quickly and accurately—without danger of crimping, flaking or cracking when you use uniformly ductile ELECTRUNITE E.M.T.

Republic
ELECTRUNITE E.M.T.
REG. U.S. PAT. OFF.
LIGHTWEIGHT THREADLESS RIGID STEEL RACEWAY


B
A
C
OF SCRAP and THAT STEEL YOU WANT
IN THE OPEN HEARTH FURNACE, A TON OF SCRAP CAN REPLACE A TON OF HOT PIG IRON... AND HERE'S WHAT IT TAKES TO PRODUCE PIG IRON
IRON ORE
IRON ORE
COAL
LIME-STONE
HOURS OF BLAST FURNACE TIME
HOURS OF BLAST FURNACE LABOR

To you "scrap" may be just worn-out machinery, broken pipe and such junk---worth nothing to your business.

But it IS worth a lot to your business delivered to the steel producer. Scrap may be the means of supplying you with more of the new steel and steel products you want.

As every buyer knows, steel is produced by "blending" hot pig iron and scrap in the open hearth furnace. Each ton of available scrap can replace a ton of pig iron. The greater the shortage of scrap, the heavier the drain on pig iron supply to produce a given tonnage of steel.

But every extra ton of pig iron produced calls for the use of approximately two extra tons of iron ore, one extra ton of coal and one extra half-ton of limestone, processed in a blast furnace, involving many extra hours of time and labor. It is obvious that there is a limit to America's blast furnace capacity. So the quickest, most effective way to produce maximum steel tonnage now is to find and use more scrap.

Help yourself to more steel by starting more scrap into the channels that serve the mills.

QUALITY YOUNGSTOWN SERVICE

YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

GENERAL OFFICES · YOUNGSTOWN 1, OHIO

Export Offices - 500 Fifth Avenue, New York City

Manufacturers of

CARBON · ALLOY · AND · YOLOY STEELS

Pipe and Tubular Products · Sheets · Plates · Conduit · Bars · Electrolytic Tin Plate · Coke Tin Plate · Rods · Wire · Cold Drawn Carbon Steel Rounds · Tie Plates and Spikes.

YOUR CUSTOMERS WANT ALL THE ADVANTAGES OF

Blo-Fan

CEILING VENTILATORS

HOME OWNERS want the latest method of keeping their walls and furnishings free from kitchen grease and cooking vapors. They don't like obnoxious odors to spread throughout the house. They want to save on cleaning bills. They demand that their new homes be kept new—fresh and clean—as long as possible.

Blo-Fans

are installed *directly over the source* of unwanted air. Whether in kitchen, gameroom, bathroom or laundry, Blo-Fans banish unwanted hot air *as it rises—before it spreads.*

Blo-Fans combine the power of the blower with the volume of the breeze fan. Not a fan—not a blower, but a patented combination of both principles with the advantages of both. That's why we say Blo-Fans, installed in the ceilings directly over the range, are much more effective than a fan across the room in an outside wall.

Economical, Blo-Fans soon pay for themselves in savings of cleaning bills and purchase of new drapes and furnishings.

Kitchens

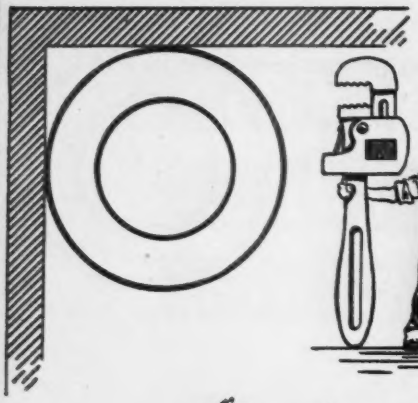
Gamerooms

Bathrooms

PRYNE & CO. INC.

LOS ANGELES 54, CALIF.

NEW YORK • CHICAGO • HOUSTON • SAN FRANCISCO



SWELL BUSHING... but how do I tighten it in a spot like this?

You don't, Buddy . . . you SWITCH TO an O. Z!

In tight spots, too— O.Z. INSULATED BUSHINGS are O.K.

In tight spots—where there's no room for a wrench—you'll appreciate the *grooved* malleable iron base of O. Z. insulated bushings.

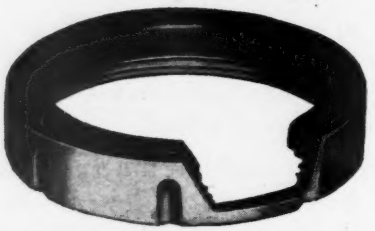
In *any* application where wire, emerging from a conduit, is bent or vibration is encountered, you'll like O. Z. insulated bushings because high-insulating Bakelite is molded and locked to a metal base.

METAL BASE means extra installation economies.

- **No stripped threads:** O. Z. insulated bushings tighten all the way down on the conduit without stripping bushing threads!
- **No inside locknut:** Deep metal base *alone* secures and grounds box to conduit!

CAPPED, TOO . . . to keep inside of conduit clean until cable is pulled.

Local suppliers almost everywhere can give you O. Z. bushings and other O. Z. products *right off the shelf*. Get in touch with your supplier today.



Other types, too—Shown is O. Z. insulated bushing Conduit Type B. . . . O. Z. also makes set screw type insulated bushings, bushings for thin wall conduit, and *grounded* insulated bushings in regular, thin wall, or set screw types.

O.Z. ELECTRICAL MANUFACTURING COMPANY

262 BOND STREET · BROOKLYN, 2 N. Y.

They're OK if they're O.Z.

CONDUIT FITTINGS • CABLE TERMINATORS
CAST IRON BOXES • SOLDERLESS CONNECTORS
GROUNDING DEVICES • POWER CONNECTORS

1765

WHAT IT TAKES TO BUILD TRUCK BODIES ON AN ASSEMBLY LINE BASIS

BIG PLANT The American Coach & Body Co., plant in Cleveland, Ohio, embraces 3 stories and several hundred thousand square feet of floor space, with a new addition on the way.

SPACE Eight acres of ground provide ample parking space for chassis or finished trucks during the processing period.

TOOLS Diversified assortment of versatile machine tools, heavy and light presses, precision welding machines and other equipment needed to mass produce truck bodies.

ENGINEERS Full complement of engineers who know how to design comfort, convenience, safety, and low operating cost into truck bodies.

EXPERIENCE Our sole business for 30-odd years has been the designing and building of utility truck bodies.

American Coach manufactures all types and styles of truck bodies for power, light, gas, and communications companies. We are the largest exclusive manufacturers of standard utilities equipment for motor vehicles.

You can depend upon a company with the facilities and experience to produce the proper equipment you need to serve others.

THE *American* COACH and BODY COMPANY

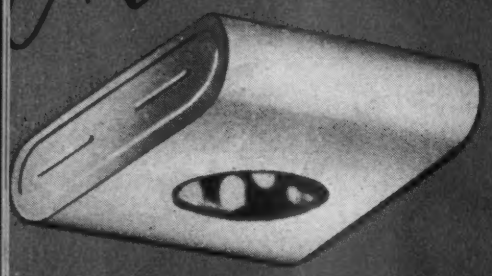
9503 WOODLAND AVE., CLEVELAND 4, OHIO

SALES and ASSEMBLY THE AMERICAN COACH AND BODY CO. OF CALIF., 432 FIFTH ST., OAKLAND 7, CALIF.
BAKER EQUIPMENT ENGINEERING CO., SUMMIT & NORFOLK STS., RICHMOND 11, VA.

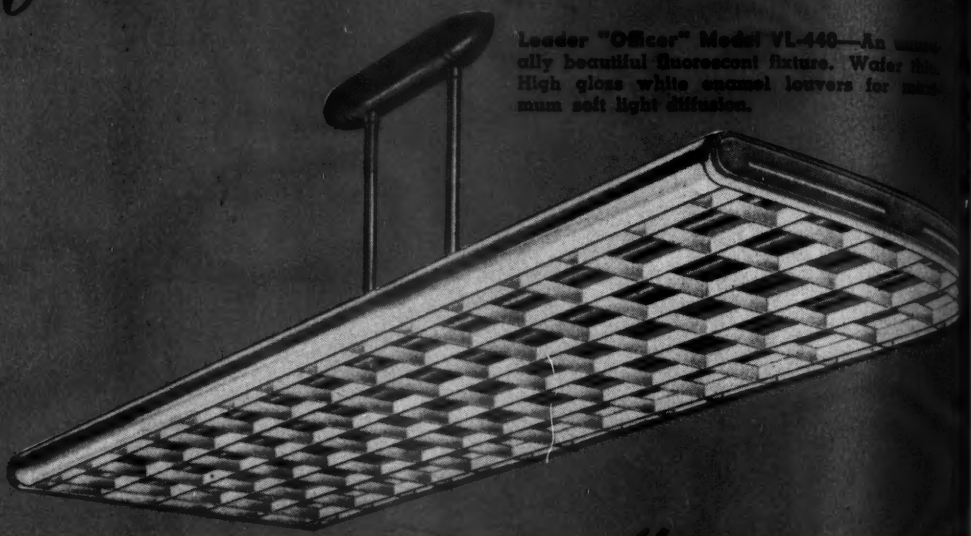
OFFICES 350 MADISON AVE., NEW YORK 17, N. Y. INSURANCE EXCHANGE BLDG., DES MOINES 9, IOWA

ACB

A STEP AHEAD *in* *Modern* DESIGN...

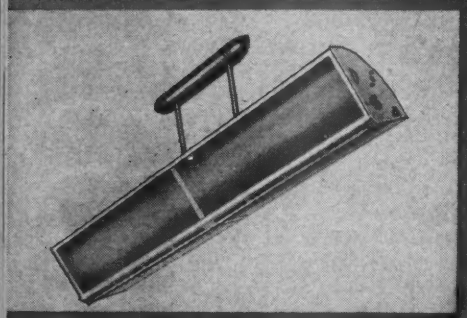


Leader Adjustable Direclite—Adds a new note to modern merchandising. May be mounted above display case in a continuous run of "Officer" units... or with a single unit... to spotlight merchandise for added sales appeal.

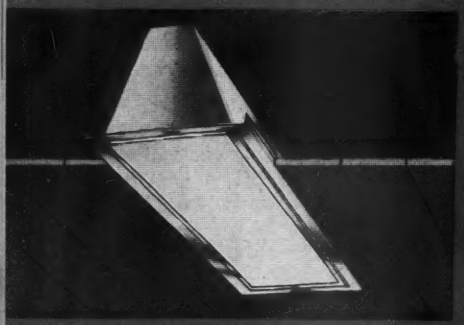


Leader "Officer" Model VL-440—An ... ally beautiful fluorescent fixture. Wafer ... High gloss white enamel louvers for max... mum soft light diffusion.

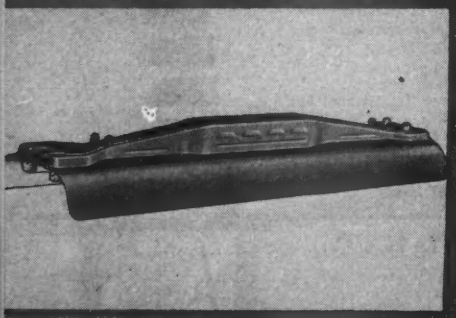
...gives the improved appearance that builds preference in schools, offices, factories for



...ader Glass Enclosed Unit GL-440—Brings luxury lighting ...thin the reach of all! Ribbed glass construction for plenty ... soft, cool light. An admirable unit for schools, stores, ...fices, hospitals.



...ader Trofferlite TG-240—An ideal fixture to use on ...modeling jobs or where a streamlined, modern, effect is ...sired. Ceiling may be hung from unit.



...ader Zephyrlite ZUO-L-240—A light, easily installed indus... ...l unit. Corrugated for unusual strength, will not warp, twist ...sag. Built to eliminate the need for installation "extras."

Leader Fluorescent Luminaires

Eye appeal . . . and lots of it . . . is one BIG reason why a constantly increasing number of architects, lighting and utility engineers, and electrical contractors now specify LEADER lighting equipment for school, institution, office and other installations.

Beautiful as they are, however, LEADER fluorescent luminaires achieve their good looks without sacrifice of lighting efficiency. Maximum "better light for better sight" is maintained by LEADER designers who combine modern styling with latest engineering and research findings.

Get acquainted with the LEADER line. There is a friendly LEADER representative in your area . . . or write for catalog direct to:

...EADER ELECTRIC MANUFACTURING CORP., 6127 N. BROADWAY, CHICAGO 40, ILL.

WEST COAST FACTORY: 2040 LIVINGSTON ST., OAKLAND 6, CALIF.

SPECIAL PURPOSE OUTLETS

THESE Outlets serve special purposes *in addition* to those served by ordinary receptacle types. Their *extra*-utility has durable basis in right design, rugged parts, reliable workmanship.

No. 7707,—Clock Hanger Outlet: Provides electrical connection and mechanical support for clock. No. 7792,—Weatherproof Receptacle with cadmium-finished brass plate, metal cap and weather-tight rubber mat. No. 7797,—Floor Outlet, with 2 threaded brass covers; one to shield plug cap and one to close outlet when not in use. No. 7750,—Fan Hanger Outlet: Provides mechanical support for fan, with electrical connection. No. 1914, — Duplex 2-circuit Receptacle; one circuit always "ON" for appliances, the other to be switch-controlled as for lamp circuit.

Ask for complete catalog listings of the types here shown as representative, as well as standard outlets and switches.

DISTRIBUTED THROUGH ELECTRICAL WHOLESALERS

HART & HEGEMAN DIVISION

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U. S. A.

Station wire insulated with GEON makes hit with 'phone men

Some advantages apply to all types of manufacturing and construction

HERE are a few of the advantages of telephone station wire insulated with GEON: it strips fast, clean, easily; it's smooth, not sticky, easy to handle; the colors are clean and bright.

Then add the fact that the excellent electrical properties of insulation made from GEON permit a thinner coating. That means lighter weight, more conductors per conduit, or smaller holes to be drilled during construction.

In addition, insulation made from GEON is self-extinguishing—won't support flame. It resists most normally destructive agents such as ozone, oils, acids, air, aging, abrasion, water, and many others.

GEON's applications range from spaghetti for radio hookup wire to heavy insulation for buried service entrance cable. That's why we urge you to specify wire insulated with GEON the next time you order from your supplier. For information about special applications please write Dept. Y-12, B. F. Goodrich Chemical Company, Rose Bldg., Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

Geon
Polyvinyl Materials
A TRADE MARK OF B. F. GOODRICH CHEMICAL COMPANY

B. F. Goodrich Chemical Company
A DIVISION OF THE B. F. GOODRICH COMPANY

IT TOOK A CUSTOMER TO SHOW ME SALES I WAS MISSING

Contractor: I hear you're having a hard time with your new housing development. I suppose wiring is going to take a beating.

Builder: No – I don't think so. Cutting the wiring to the absolute minimum won't save enough to make it worth while. I have a reputation for building up-to-date homes, you know, not houses that are obsolete before the paint is dry. I want to protect that reputation.

Contractor: You mean to say that you will insist on a real adequate wiring job even in your low-cost houses?

Builder: I sure will. In my low-cost houses I'll have to omit some of the extras that people want. But small home owners use just as much electricity as people who live in large homes – even more maybe. And I sure won't leave out anything as essential as a sound wiring system.

Contractor: I'm real glad you feel that way. And I'm sure that good wiring will not only help to sell your houses, but will keep the owners satisfied as long as they live in them. That's a selling idea I'm going to start pushing right now.

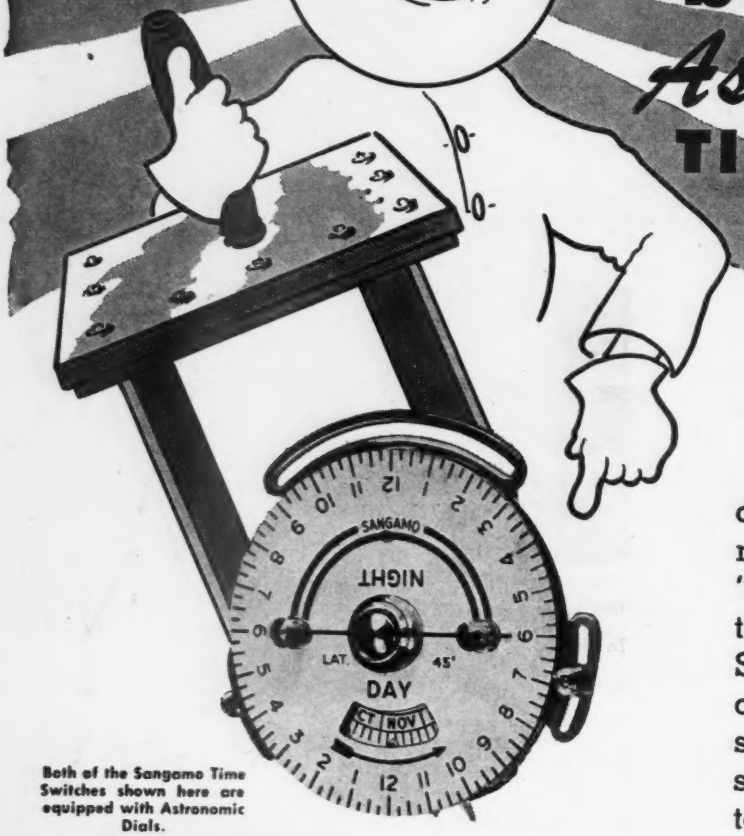
P.S. Why not ask *your* G-E representative how you can benefit from the promotion of adequate wiring in residential, industrial, and other buildings. Or you may want to write for information to Section AW16-128, Appliance and Merchandise Department, General Electric Co., Bridgeport, Conn.

GENERAL ELECTRIC

ADEQUATE WIRING SERVES AND SAVES — THE KEY TO THE HOME OF TOMORROW

THEY TAKE "ON" AND "OFF" TIMES FROM THE SUN

SANGAMO
Astronomic Dial
TIME-SWITCHES



Both of the Sangamo Time Switches shown here are equipped with Astronomic Dials.

Automatic in Operation

• The daily change in the length of day and night throughout the year necessitates periodic re-settings of the "on" and "off" operations of conventional time-switches. Not so with a Sangamo Time-Switch equipped with an Astronomic Dial! For convenience sake, it is frequently preferable to specify this control which is fully automatic, and requires no re-setting. On flood-lighting, yard-lighting, and especially on advertising-lighting installations, the "on" and "off" operations change every day in exact accordance with the setting and rising of the sun. There are other features of convenience described with the Sangamo Time-Switches shown on this page. Decide on what you need—then order for future delivery.

FORM KAZ

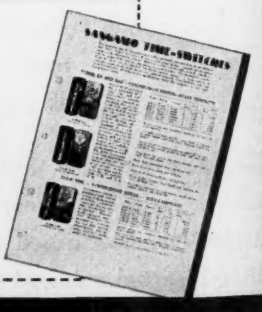
In addition to the astronomic "on" and "off" operation, this switch permits the "off" operation at any time between 9:30 P.M. and 2:15 A.M. If desired the time-switch can be operated manually without affecting subsequent automatic operations. It is available in a wide variety of combinations providing two-circuits, duplex, and outdoor switches; also with Sunday and holiday omitting device, as well as advance time cutoff.

FORM VSWZ

Equipped with astronomic dial, Form VSWZ also provides for continuous operation during power interruptions through its electrically wound movement — although it is normally synchronous motor operated. This "carryover" feature is entirely automatic, eliminating the necessity of resetting the dial after power interruptions up to ten hours, thus insuring dependable and accurate timing under all conditions.

WRITE NOW FOR CIRCULAR NO. 205

It contains compact and concise information on the wide variety of control features available in various forms of Sangamo Time-Switches, including outdoor types.



SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

modern proverb

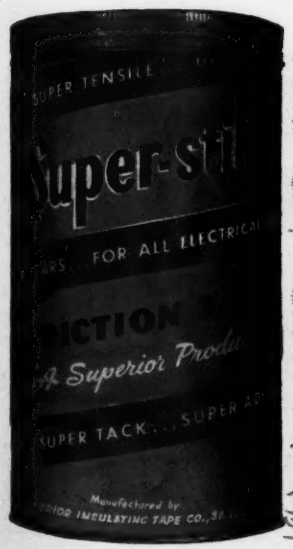
Super-stik splice ~~Variety~~ is the ~~spice~~ of life

Webster defines a proverb as: "A short, familiar pithy saying expressing some *well known truth* or common *fact of experience*". To the wireman who knows the importance of a permanent splice, the high tensile, adhesive and tacky properties of SUPER-STIK tape are proverbial. He appreciates a non-ravelling, non-curling, non-peeling tape . . . it sticks to the job, not to the hands. These well-known facts enable us to offer . . . SUPER-STIK, the SPLICE of LIFE.

Write for a free "Test-it-yourself" splice. Mailed without charge.

Water soak it. Sun bake it.
You'll see why Super-stik is best.

SUPERIOR INSULATING TAPE CO.,
St. Louis, Mo., U.S.A.
Established 1923



PACKED 10 ROLLS TO THE CAN

Super-stik

FRICTION TAPE

"Sticks to the End"

Cooler Cables in Transite Ducts Carry Heavier Loads

Increases of as much as 15% in current carrying capacity have been measured in cables sheathed in Transite Ducts!

The figures in the test case illustrated, made by Johns-Manville Research Engineers in collaboration with several leading cable engineers, apply to a single Transite Duct compared with an organic duct.

Transite Ducts have been proved to dissipate I^2R losses 13% faster than other ductways tested, thus keeping cables cooler. Higher load capacity, reduced copper losses and increased cable insulation life are the results.

Made of asbestos and cement, Transite Ducts are strong, immune to rust and rot. They are incombustible and unaffected by electrolysis or galvanic action. A permanently smooth bore makes possible long cable pulls and easy replacements. Long, lightweight lengths can be quickly and economically installed. In addition, a full line of fittings simplifies even the most complicated installations.

HOW TRANSITE DUCTS INCREASE CABLE CARRYING CAPACITIES

Tests made on a lead-sheathed 500,000 CM cable insulated with ½" paper and placed inside a single duct encased in concrete.

Sheath Temperature, 145° F.
Ambient Air Temperature, 90° F.

CURRENT CARRYING CAPACITY

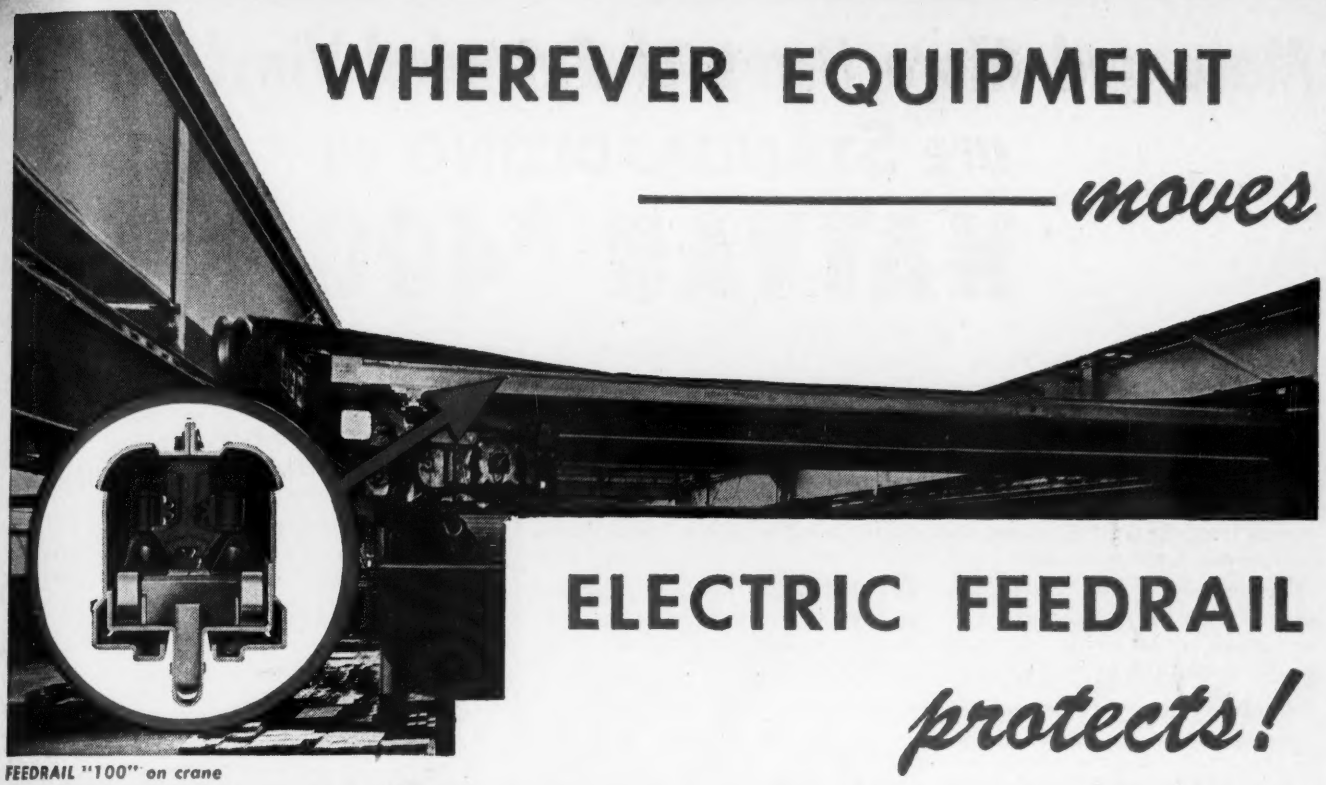
Transite Duct	796 amperes
Organic Duct	691 amperes
Difference	105 amperes

(Figures are results of tests conducted in the J-M Laboratory in collaboration with several leading cable engineers.)

For full information on Transite Ducts, write for Data Book DS-410. Johns-Manville, Box 290, New York 16, New York.

Johns-Manville **TRANSITE DUCTS**
CONDUIT for use without concrete
KORDUCT for concreting in

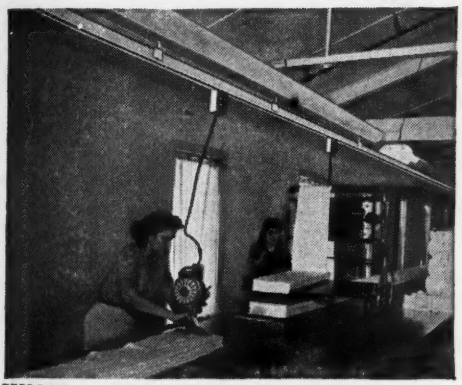
WHEREVER EQUIPMENT ——— *moves*



FEEDRAIL "100" on crane

ELECTRIC FEEDRAIL *protects!*

Whenever you see exposed wires on a crane system, wires on the floor or awkward motions of portable tool operators — think of FEEDRAIL.

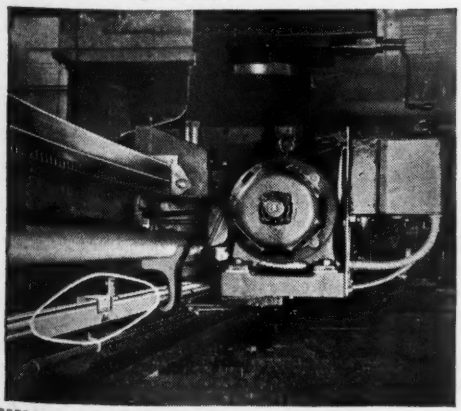


FEEDRAIL on cutting and moving cloth laying machine

CRANES AND HOISTS

Electric Feedrail is an enclosed bus bar system having movable trolleys that make contact with the bus bars at all times. It is polarized, fused and grounded and each section carries the Underwriters' Label.

FEEDRAIL is protected against dust, mechanical injuries and mechanical shorts. It is furnished in assembled sections and curves. Also available for Slide Switches and transfers. Easy to install, inspect and service.



FEEDRAIL on machine tool

PORTABLE TOOLS

FEEDRAIL not only feeds but also supports all types of portable tools which may be readily disconnected by means of fused EVER-LOK connectors.

TEST RACKS

or any electrical equipment that has to be moved or rearranged to accommodate new production layouts is best served by FEEDRAIL.

ASK FOR FEEDRAIL CATALOGS GENERAL No. 15, NEEDLE TRADES No. 16, MACHINE TOOL No. 17

14

ELECTRIC FEEDRAIL

FEEDRAIL CORPORATION

Subsidiary of Russell & Stoll Company

125 BARCLAY STREET NEW YORK 7, N. Y.

More and More Users of Extruded Vinyl Tubing are STANDARDIZING on NATVAR #400

Here's Why:-

Most users, to make sure that they get the right tubing for a particular job, run tests on the various extruded tubings available to find out whether they are suitable. For some applications, heat resistance is of primary importance. For others, it may be tensile strength, high dielectric, oil resistance, low moisture absorption, or a combination.

Before Natvar #400 was available, it was often the practice to stock several different types of special purpose tubings. This is no longer necessary. Test reports show that Natvar #400 is able to hold its own on practically every count for which a special purpose tubing might be considered.

One of the largest electrical manufacturers reports:

> This tubing has been used in radio transformer construction here at ——— for some time, and it has been found satisfactory ... A comparison of our results with those of the supplier is very favorable ... One peculiar characteristic of this material is the manner in which it behaves after immersion in hot transformer oil. A sample before immersion gave a tensile strength of 4140 psi, and after immersion a tensile strength of 6890 psi. ... The sag test which was conducted in this investigation was more severe than is usually conducted on materials of this type. Nevertheless, this tubing performed remarkably well under these conditions ... A copy of this report is being sent to the various division engineers for review.

Another large electrical manufacturer reports:

> MATERIAL TESTED: #400 Natvar Tubing, Flexible Extruded Vinyl.
>
> Effect of Heat: Like any other plastic, this material softens upon heating, but at 125° C. it does not flow or sag. It remains unaltered, except for darkening, after a week in the drying oven.
>
> Effect of Oil: In oil at 100° C., the tubing does not swell, soften, dissolve or harden. It remains unchanged except for a change in color.
>
> Effect of Compound Treatment: The tubing flatted out due to heat, but was still pliable when removed. It is satisfactory for this application.
>
> Dielectric Strength: Dielectric Puncture Tests, using a metal rod as inner electrode, and copper ribbon as outer electrode, gave the following results (tested in oil at room temperature):

	Short Time	Step-by-Step
As received	19,000 v=725 v/mil	17,600 v=691 v/mil
Dried 2 days @ 125°C	19,000 v=744 v/mil	16,800 v=667 v/mil
Dried 3 days @ 125°C plus 24 d. in oil : 100°C	26,000 v=1023 v/mil	19,400 v=723 v/mil

Underwriters' Laboratories limitations permit wide use. Natvar #400 is now available for immediate shipment in most sizes, either from your wholesaler's stock or from our own. Write, wire or phone us your requirements.

Excerpts from the E.T.L. report covering tests made on Natvar No. 400 in accordance with A.S.T.M. Standards.

DIELECTRIC STRENGTH—A.S.T.M. D350-43
Average volts per mil: At 28°C—1090
At 85°C— 700
Wall thickness: .0235"

DIELECTRIC CONSTANT AND POWER FACTOR
Dielectric constant at 29°C and relative humidity 60%
At 60 cycles: 8.15
At 1 megacycle: 4.35
Power Factor: At 60 cycles: .056
At 1 megacycle: .064

ARC RESISTANCE—A.S.T.M. D495-42
Average—135 seconds

OIL RESISTANCE—A.S.T.M. D295-43T
"Turbol 10" at 105°C was used. After 15 minutes immersion there was no apparent change in the tubing. After 24 and 48 hours there was no sign of change in the tubing. Three separate tests were made.

HEAT ENDURANCE—A.S.T.M. D350-43
After 7 days at 125°C the tubing did not crack or otherwise fail when bent 180° around a 5/16" mandrel.

TENSILE STRENGTH AND ELONGATION
At 200% elongation: Average 1980 lbs. per sq. in.
At Maximum: Average 2870 lbs. per sq. in.
Total elongation: 350%

LOW TEMPERATURE FLEXIBILITY
After 3 hrs. at minus 30°F specimens were bent around a mandrel 5/16" in diameter. There was no sign of cracking or other failure.

FLAME RESISTANCE—D350-43
Burned about ¼ in. in 10 to 15 seconds and then went out. Three tests were made.

EFFECT OF CHEMICALS
Effect of 7 days immersion in solvents at room temperature; average of 3 tests in each solvent:

Solvent	Change in weight Per cent of weight of specimen as received	Change in dimensions Per cent of dimensions of specimen as received Length	Outside diameter	Thickness
5 per cent sulfuric acid	+ 0.41	none	none	none
1 per cent potassium hydroxide	+ 0.83	none	none	none
Petroleum	+ 6.62	+2.6	none	none
Ethyl Alcohol	+ 1.66	none	none	none
Benzol	+21.9	+6.6	+10.9	—24.0

WATER ABSORPTION
Average of 5 tests

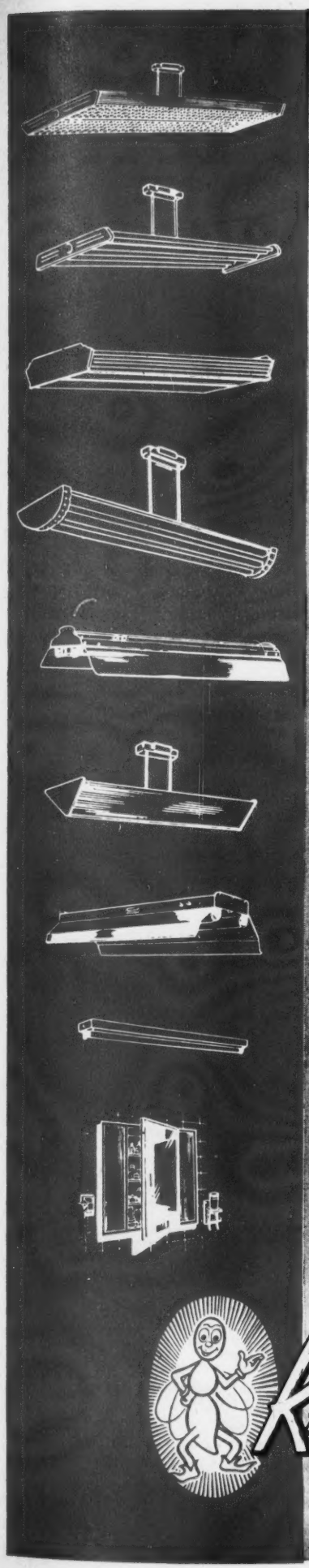
Water absorption, per cent by weight of dry specimen	0.63
Soluble matter, per cent by weight of dry specimen	0.01
Total water absorption, per cent by weight of dry specimen	0.64
Change in dimensions: in length	none
in outside diameter	none
in thickness	none

THE NATIONAL VARNISHED PRODUCTS Corporation

TELEPHONE RAHWAY 7-2171

CABLE ADDRESS NATVAR: RAHWAY, N. J.

205 RANDOLPH AVENUE ★ WOODBRIDGE NEW JERSEY



FIREFLY

wishes you

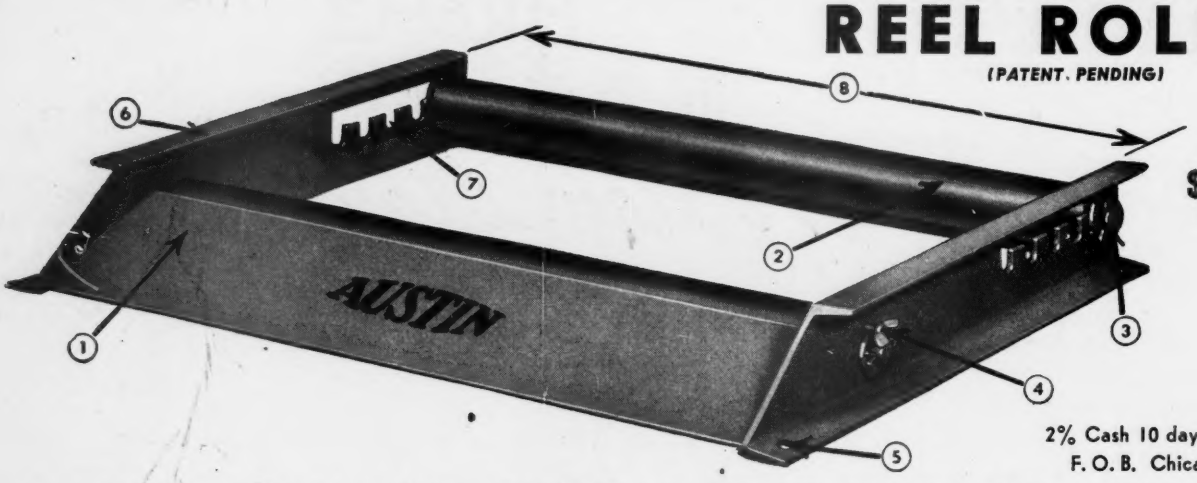
A New Light Year

KAHN MFG. CO. INC.

2051 NORTH 19TH STREET MILWAUKEE 5, WIS.

IMMEDIATE SHIPMENT · · AUSTIN REEL ROLLER

(PATENT PENDING)



$37.50 ea.

2% Cash 10 days; Net 30 days
F. O. B. Chicago, Illinois

FOR DISPENSING ANY MATERIAL THAT IS WOUND ON A REEL

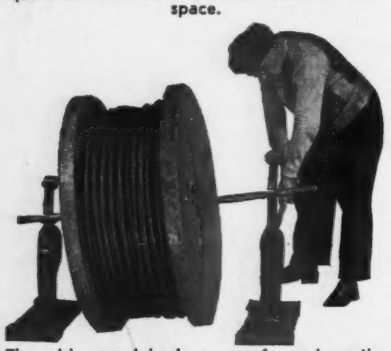
The new quick, easy and safe way. Reel is loaded in a jiffy with little or no effort. Requires a minimum amount of valuable floor space.

EVERY Electrical Contractor, Utility, REA Co-operative, Shipyard, Railroad and Wholesaler, should have several of these indispensable AUSTIN REEL ROLLERS. When pulling one or more cables into conduit, use an AUSTIN REEL ROLLER for each cable. Can be mounted stationary; or used on the job as a portable device—ideal for service and repair trucks.

Here's the best, the most economical investment you ever made—AUSTIN NO. 600 REEL ROLLER at $37.50 each. Prompt shipment.

9 OUTSTANDING ADVANTAGES

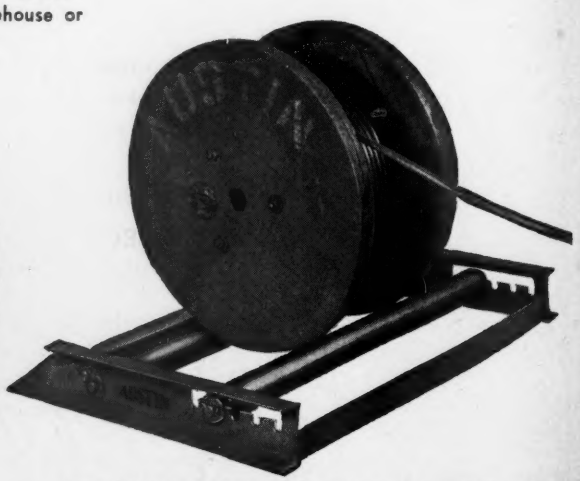
(1) Ramp—Makes it quick and easy to load the reel onto the rollers.
(2) Back roller is mounted slightly higher, preventing the reel from being pulled off the roller when cable is removed.
(3) Reel rolls on grease packed flanged ball bearings with the greatest of ease and safety.
(4) Thumb screw, which when tightened, prevents roller from turning for easy removal of reel.
(5) Hole for lag screw, one in each corner for stationary mounting.
(6) Heavy steel frame, painted bright orange, not only adds to its appearance, but, also makes it readily visible on the floor which helps to eliminate accidents.
(7) Five adjustable slots to accommodate various reel diameters. No screws, washers or cotter pins to remove—simply raise up the roller and slide into the slot required.
(8) Will take any size reel up to 30" in width. For larger reels, use two reel rollers and mount end to end.
(9) Can be used in the warehouse or on the job.



The old way—laborious, unsafe and costly.

AUSTIN REEL ROLLERS, like all AUSTIN Products, are sold exclusively through your Electrical Wholesaler. Send him your order today.

THE AUSTIN REEL ROLLER makes this an easy one man job.



Note the roller adjustment for this small diameter reel.
MAXIMUM CAPACITY 4000 LBS. WEIGHT 75 LBS.

THE M. B. AUSTIN CO.

108-116 S. DESPLAINES STREET
CHICAGO 6, ILLINOIS

IF you want to "START" something

—use "3C" TYPE D PUSH BUTTON STATIONS

3 UNIT WITH HOLD-DOWN LOCK
4 UNIT WITH PILOT LIGHTS
10 UNIT WITH PILOT LIGHT, SELECTOR SWITCH, MUSHROOM HEAD
6 UNIT, SMALL MUSHROOM HEAD
2 UNIT STATION
5 UNIT WITH SELECTOR SWITCH
1 STATION MUSHROOM HEAD
PENDANT TYPE
TYPE RN
WATER TIGHT, NEMA IC50-43
DUST TIGHT, NEMA IC50-28
OIL IMMERSED, for CLASS 1, GROUP D, HAZARDOUS LOCATIONS
START
STOP
DOWN-IN

● Clark Type D Push Buttons, featuring silver-to-silver, button-type, double-break contacts, bakelite insulating parts, large electrical clearances, and plenty of wiring space, provide low maintenance and long life in heavy duty operations. Push button stop is independent of contacts. 1½" and 2¼" mushroom heads are available.

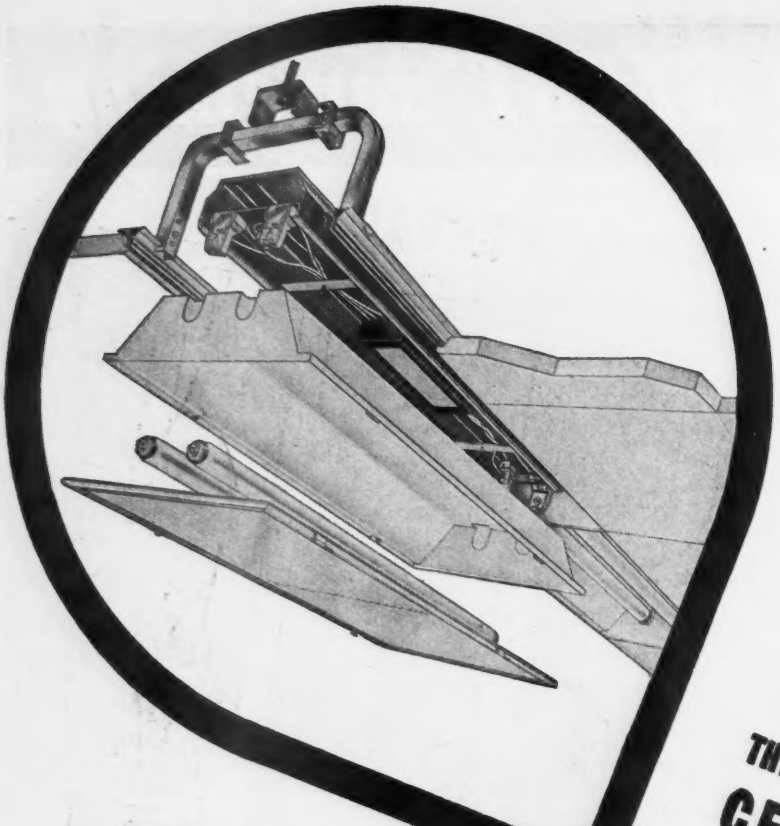
Type RN — the "ROUGHNECK" — has mushroom head, cast metal enclosure with rounded shoulders sturdy enough to take rough usage.

Watertight, dust tight, and oil-immersed types can be supplied. Pendant Stations are also available.

For every heavy duty industrial push button application there's a "3C" Push Button Station available.

THE CLARK CONTROLLER CO.

1146 EAST 152nd ST., CLEVELAND 10, OHIO • OFFICES IN PRINCIPAL CITIES



Installed in a commercial area of any size — the MILLER FLUORESCENT TROFFER LIGHTING SYSTEM gives you (1) perfect light for easy-seeing; and (2) a distinctive, impressive ceiling treatment. Good lighting is made an integral part of the architecture! Furthermore, you get a saving! The continuous wireway channels reduce wiring costs, conduit and conduit fitting costs, from 50% to 80%. The patented Miller Ceiling Furring Hanger improves and simplifies installation. The versatility of application of the Troffer System offers limitless design opportunity — CEILINGS UNLIMITED — while fulfilling its primary purpose — IDEAL LIGHTING.

THE LIGHTING SYSTEM THAT PROVIDES CEILINGS UNLIMITED

MILLER
SINCE 1844

THE MILLER COMPANY • MERIDEN, CONN.

ILLUMINATING DIVISION

ILLUMINATING DIVISION
Fluorescent, Incandescent Mercury Lighting Equipment

ROLLING MILL DIVISION
Phosphor Bronze and Brass in Sheets, Strips and Rolls

FOUNDRY DIVISION
Non-Ferrous Metal Castings

HEATING PRODUCTS DIVISION
Domestic Oil Burners and Liquid Fuel Devices

RUBBER SPLICING TAPES THAT S-T-R-E-T-C-H and SEAL!

The high elongation and tensile strength of PANTHER and DRAGON Rubber Tapes are important qualities in making them wrap smoothly. And their excellent fusing characteristics bond successive layers into a watertight splice.

They have high dielectric strength — they're made by a company that has specialized in electrical insulation for nearly 70 years.

Friction Tapes also are available in PANTHER and DRAGON brands. All tapes meet A.S.T.M. and government specifications.

PANTHER AND DRAGON friction & rubber TAPES

Sold Through Recognized Independent Wholesalers

HAZARD
INSULATED WIRE WORKS
Division of The Okonite Co.
Wilkes-Barre, Pennsylvania • Offices in Principal Cities

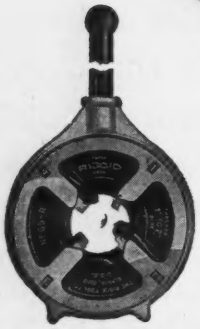
All PANTHER and DRAGON Tapes are sold only through recognized wholesalers.

4832

Thread pipe with almost automatic speed and ease...

RIDGID No. 65R

10 Second Size Adjustment
•
Instant-Setting Workholder

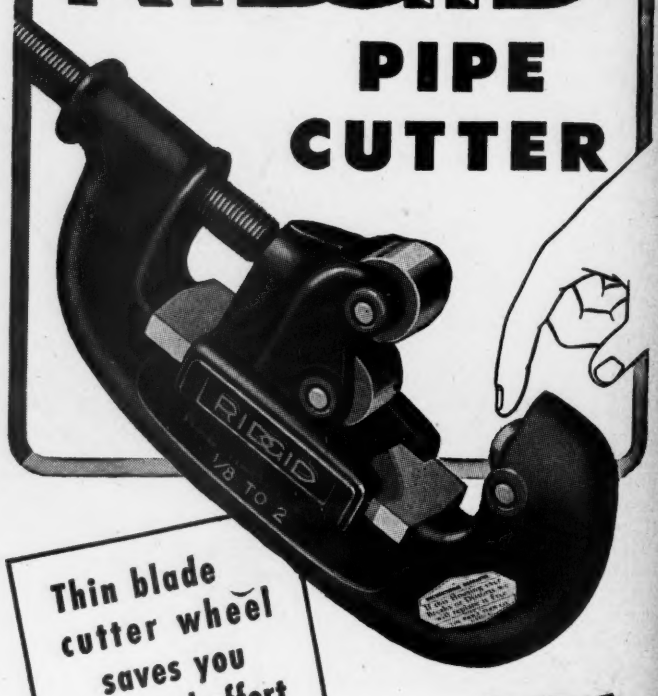


Extra convenience . . . it stands up!

● Top speed in threading 1" to 2" pipe — and least monkey business getting ready — that's the self-contained No. 65R, widely popular everywhere. Workholder gauge-plate turns instantly to size — only 1 screw to tighten on pipe, no bushings to bother with. High-speed steel chasers set to size in 10 seconds, cut smooth perfect threads as if steel pipe were made of lead. You enjoy using this durable all-steel-and-malleable No. 65R — at your Supply House.

You cut pipe fast, easily and clean with this efficiency-balanced

RIDGID PIPE CUTTER



Thin blade cutter wheel saves you time and effort

● Nothing short of a motorized machine gives you as quick pipe cutting with as little work as this improved RIDGID. It "feels" efficient when you pick it up. Its new balanced malleable frame and thin-blade tool-steel wheel assure true cuts, almost burr-free — and fast — with surprisingly small muscular effort. Five factory-tested sizes meet your needs to 6" pipe. Save time — ask your Supply House for the RIDGID Pipe Cutter.

4-wheel cutters to 4" for fast quarter-turn cutting.

Millions of RIDGID Tools in use

★ RIDGID ★

WORK-SAVER PIPE TOOLS

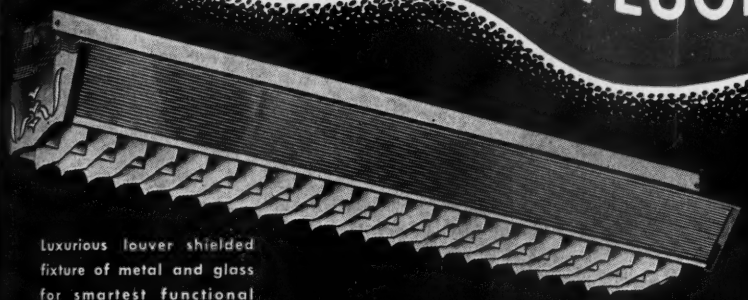
The Ridge Tool Company
Elyria, Ohio, U. S. A.

Announcing...

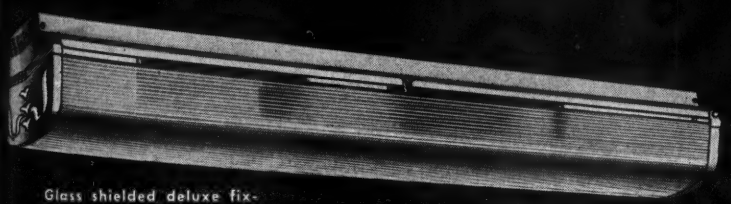
LIGHT-IN-LINE

MULTI-STYLE ... MULTI-PURPOSE

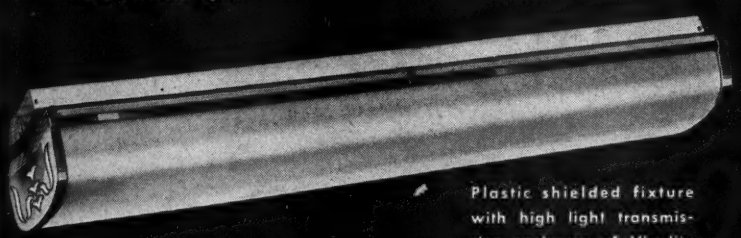
Commercial FLUORESCENT LIGHTING



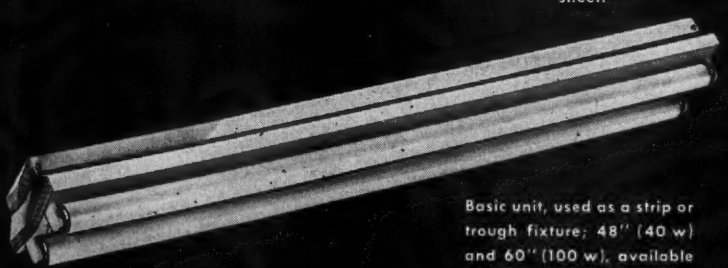
Luxurious louver shielded fixture of metal and glass for smartest functional effects.



Glass shielded deluxe fixture with Corning Alba-Lite enclosure for efficient, diffused glareless light.



Plastic shielded fixture with high light transmission enclosure of Vinylite sheet.



Basic unit, used as a strip or trough fixture; 48" (40 w) and 60" (100 w), available in 2 and 4-light sizes.

A COMPLETE COMMERCIAL LIGHTING LINE FOR WIDEST RANGE OF APPLICATION

Here is supreme beauty of line and design... Single or continuous-row lighting... Flush or pendant mounting... Louvered, glass, or plastic enclosed, or strip lighting. Unparalleled opportunity to provide efficient lighting in a wide variety of fixtures of integrated design, easily and quickly installed... Sixteen beautifully styled fixture combinations with a minimum of stocking, thanks to Moe-Bridges *engineered* use of the basic unit principle.

√ CHECK THESE FEATURES

- Covers entire range of open, louvered and enclosed lighting; 2 and 4-light; 40 and 100 watt.
- High level lighting... pendant or flush mounting; single or continuous-in-line rows.
- Bases and shields individually packaged, labeled, for easy stocking and handling.
- Makes possible delivery of large orders from an economical inventory.
- Convertible to instant start without changing ballast.
- Clean lighting: louvered fixture is dust-and-dirt-free; plastic and glass fixtures, being completly enclosed, are dust-and-dirt-*proof*.
- Easy to maintain: enclosures swing open for easy access; wiring channel also accessible.
- Designed for one-man installation: basic units and enclosures each assembled complete, requiring no supplementary parts.
- Underwriters Laboratories approved.
- Union-Made... (I.B.E.W. label.)

Write!

Send today for LIGHT-IN-LINE folder illustrating and describing this distinguished line in full detail.

MOE-BRIDGES CORPORATION
Dept. 512 Sheboygan, Wisconsin

Please send me the LIGHT-IN-LINE folder.

Company Name_____

Individual_____

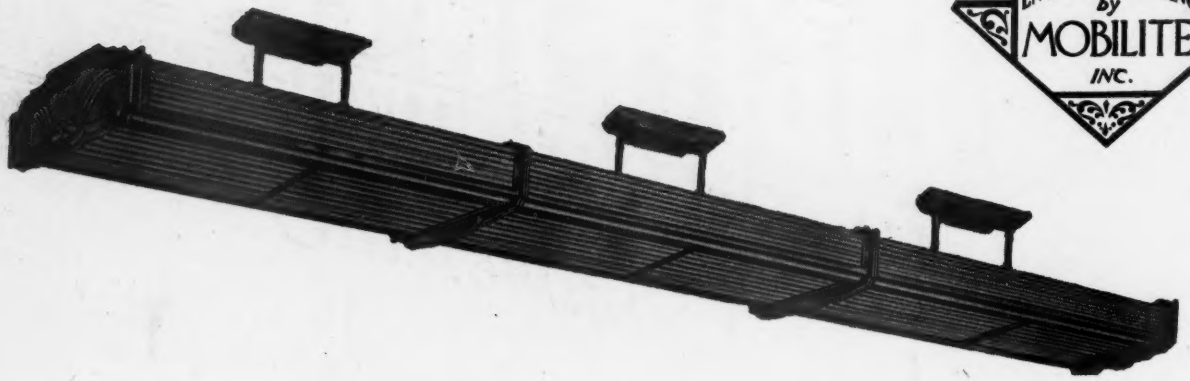
Street_____

City_____ Zone_____ State_____

MOE-BRIDGES *Corporation*

SHEBOYGAN, WISCONSIN

OVER 25 YEARS LEADERSHIP IN THE LIGHTING FIELD



ENGINEERED LIGHTING by MOBILITE INC.

MINIMIZED MAINTENANCE

is only one of the features in the Mobilier line of

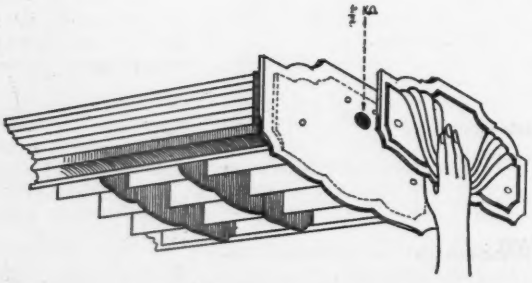
"SUPER-VISION MOBILIERS"

for ENGINEERED LIGHTING in stores, showrooms, banks, offices and other commercial requirements where both smartness and efficiency are demanded.

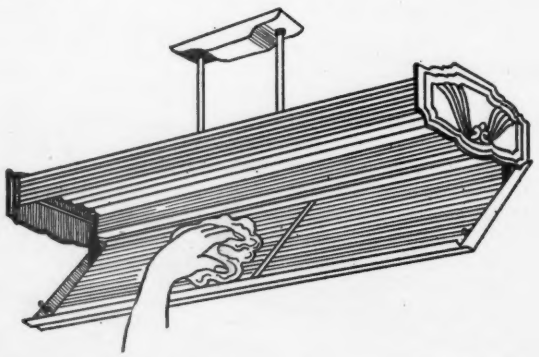
This series of outstanding Mobilite fixtures is unusually well liked because it is so remarkably diversified in usefulness. Each Mobilier unit may be used for high or low ceilings or under balconies. By use of readily available accessories, these units become Suspension Units (double or single stem); Surface Mounting Units or may be combined for Continuous Run.

Supervision Mobiliers are not only practical for ease in installation and maintenance, they also combine design excellence, scrupulous workmanship and long-lasting performance.

Write for Catalog "J"



All ornaments on Mobilier Units are easily removable for continuous runs by removing two nuts from end plate.
Single units are readily convertible to continuous run by removing ornamental end as illustrated above.



Supervision Mobiliers are easy to service. Slight pressure on spring button release at ends of unit permits ample opening for servicing . . . These fixtures may be relamped from top or bottom . . . Another exclusive Mobilite Feature.

SOLD THRU WHOLESALERS ONLY

MOBILITE Inc.

440 Mercer Street
Jersey City 6, N. J.

Manufacturers of Fluorescent Lighting

Straight Connectors
All good types— in a complete range of sizes.
Tees—
Multifit, numerous clamp types, bolted, yoke-and-nut tees, etc.
for the Complete line of Conductor Fittings—see the PENN-UNION Catalog
Grounding Connectors
For all combinations of pipe, rod, flat bar, braid, tubing.
Lugs—
Vitite, clamp types, with multi-slit sleeves; also soldering lugs, shrink fit, etc.
Service Connectors
Yoke-and-nut types; service entrance connectors.
And—
Meter cabinets, bus supports, motor lead connectors, cable taps, fuse clips, etc.
And—
Terminal blocks, bows, solderless terminal adapters, dead end clamps, etc.

You can find the exact fitting you need in the Penn-Union Catalog— practically every good type, in a complete range of sizes. The few here can only suggest the variety.

We also have thousands of other types— new designs are constantly being added. When you need a special conductor fitting for an unusual service, our engineering staff is always ready to help you.

And— Every Connector is Dependable. When you use any Penn-Union fitting, you are sure of a connector that's reliable mechanically and electrically— carefully designed, thoroughly tested, and manufactured under rigid engineering supervision.

Preferred by Leading Users, who have found that "Penn-Union" on a fitting is their best guarantee of unfailing service.

Sold by Leading Wholesalers

PENN-UNION ELECTRIC CORP.
Erie, Pa.

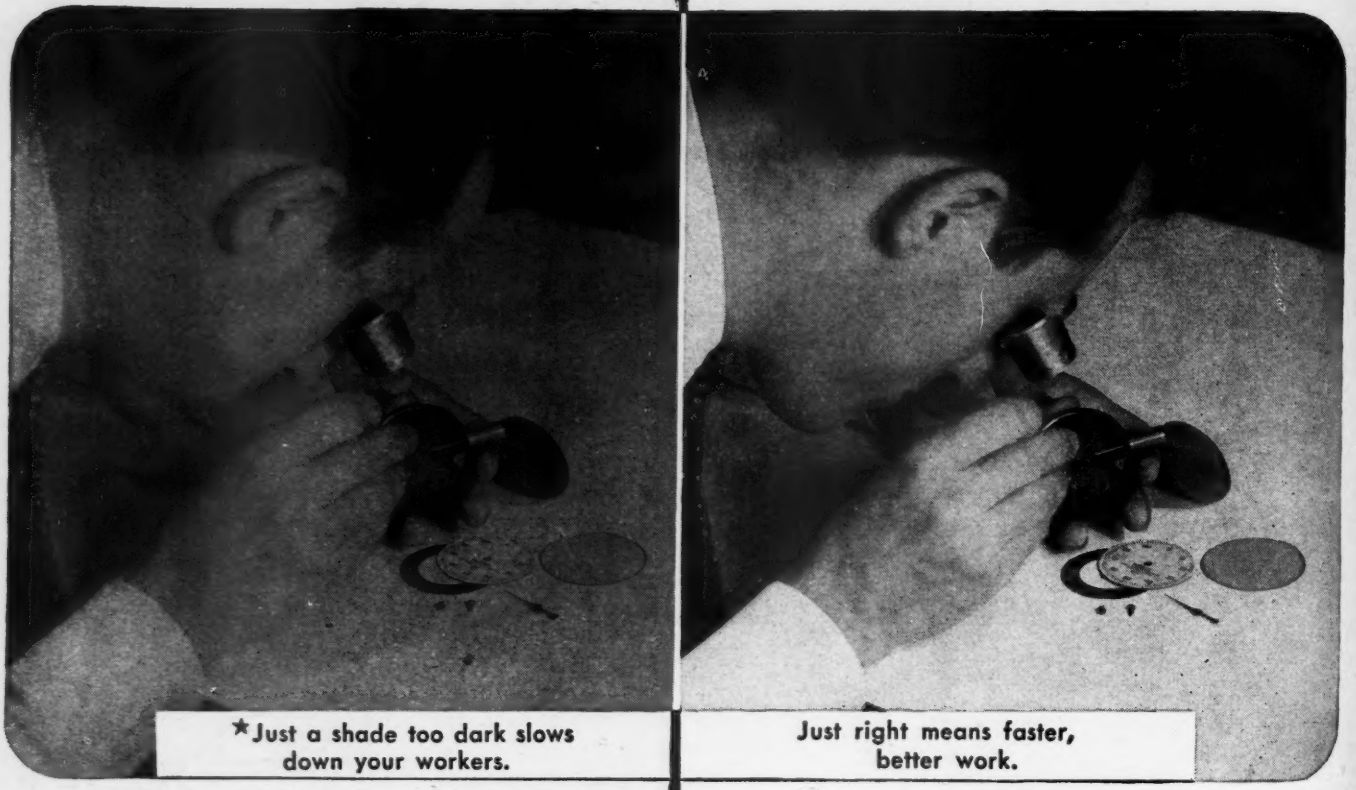
Canada: Dominion Cutout Company, Ltd., 250 Richmond St. West, Toronto

THE *Complete* LINE OF CONDUCTOR FITTINGS

PENN-UNION

BORDERLINE VISION*

May Be Slowing Your Workers



*Just a shade too dark slows down your workers.

Just right means faster, better work.

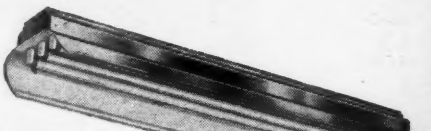
You Can Speed Up Production With Wheeler Skilled Lighting!

Lighting that's just a shade too dark or too glaring is hard to spot at a glance. But...

Borderline Vision in many a plant means little, individual production slowdowns. Little slowdowns because a careful worker has to look twice to do the job right – because a careless worker may look once and do it wrong. Little slowdowns that add up to an expensive lag in your production.

That's why better, faster work is almost automatic when you put in Wheeler Skilled Lighting. For 64 years Wheeler has specialized in light engineering. Wheeler units are designed to *control* light – to get maximum illumination from standard lamps. Their high reflection factor puts light to work where it belongs: on the job. And their rugged, porcelain enamel-coated construction means longer service and easier maintenance.

That's why it will profit you to write today for catalogs giving full details on the complete line of Wheeler Fluorescent and Incandescent Reflectors. **Wheeler Reflector Co., 275 Congress St., Boston 10, Mass.** Representatives in New York and principal cities.



All-Steel Open-End Fluorescent Unit
Available for two or three 40-watt, or two 100-watt lamps. Broad wiring channel with accessible, enclosed ballast. Mounts from chain or conduit, individually or in continuous runs.

RLM Solid Neck Incandescent Reflector

Maximum lighting efficiency for either indoor or outdoor use. Expertly designed, ruggedly built. 75 to 1500 watts.

Distributed Exclusively Through Electrical Wholesalers

Wheeler Reflectors

SKILLED LIGHTING

MADE BY SPECIALISTS IN LIGHTING EQUIPMENT SINCE 1881

There's a size and type of

CENTRAL SPANG CONDUIT

to fit your needs

If you need small or big conduit . . . raceways for hazardous locations or to resist corrosion . . . Central Rigid Steel Conduit will meet your requirements.

Central Rigid Steel Conduit is made in a wide range of sizes from ⅜ inch to 6 inches, in convenient 10 foot lengths.

Two types are available: *"Cenlaco"* offers complete corrosion protection against weather and chemicals because the inside and outside surfaces have a hot dipped galvanized and lacquered finish. *"Central Black"* has a permanent baked-on black enameled finish that will not crack, chip or flake under the severest bending strains. And it will provide wiring with permanent protection against chemical corrosion.

Both types of Central Rigid Steel Conduit meet all the National Electrical Code specifications for moisture, vapor and dust proof requirements in hazardous locations or occupancies. Every length of Cenlaco and Central Black Conduit is inspected by Underwriters' Laboratories and carries their label of approval.

All pipe used for Central Rigid Steel Conduit is carefully selected. It must have good ductility, strength and accurate diameter. That's why you can easily cut, thread or bend Central Rigid Steel Conduit. These qualities assure safe, permanent installations and tight, trouble-free joints.

There's a tremendous demand for Central Rigid Steel Conduit. This, plus material shortages, may make it difficult at times to get all of the Central Rigid Steel Conduit you want. But keep in touch with your jobber—he will make sure you get your share of the available supply.

"There's Tested Strength in Every Length"

Inside surfaces of Central Rigid Steel Conduit are inspected with the aid of strong lights. That's why you're assured that every length you receive has a smooth inside surface which permits wire to be easily inserted or withdrawn.

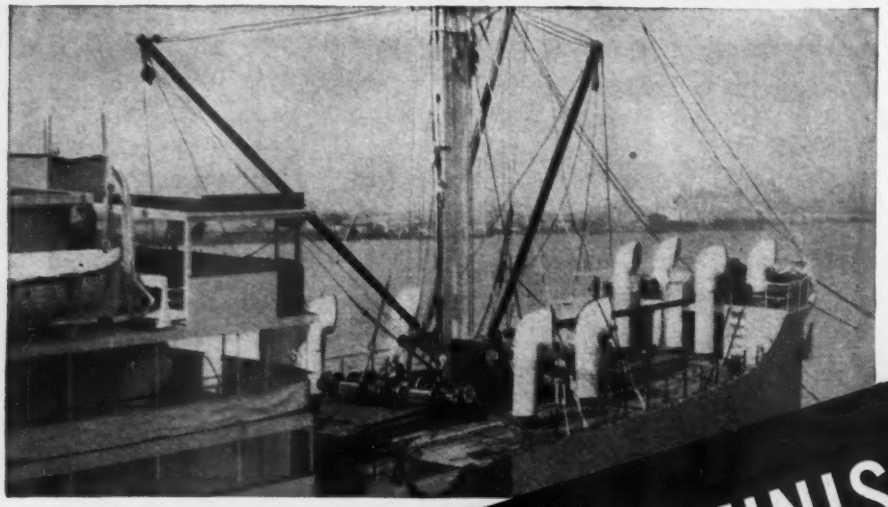
SPANG-CHALFANT

Division of The National Supply Company

General Sales Offices: Grant Bldg., Pittsburgh 30, Pa.

District Offices and Sales Representatives in Principal Cities

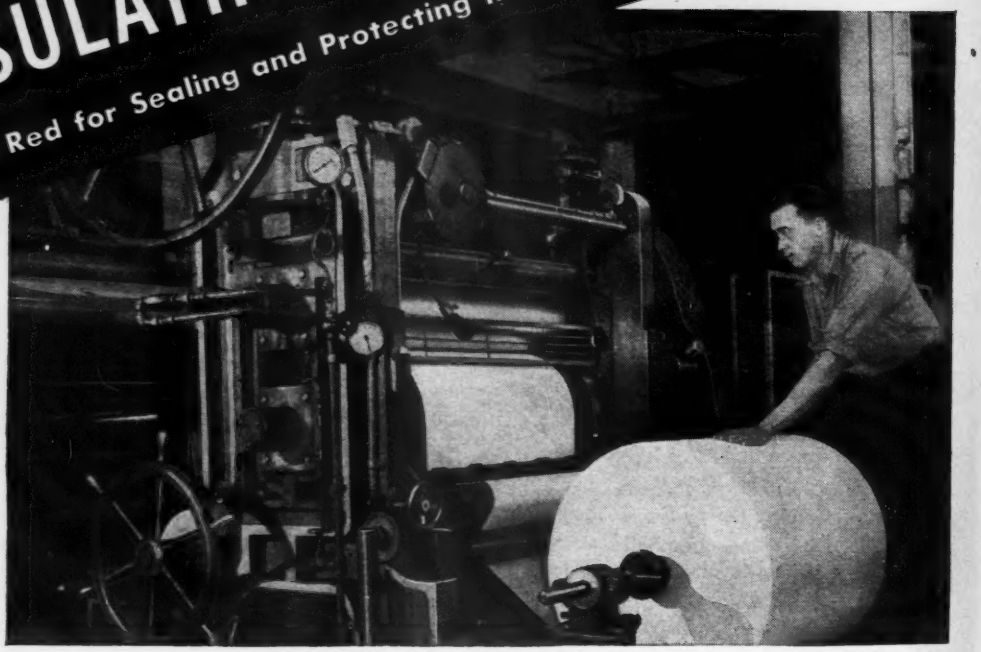
No electrical equipment can be any better than its insulation



This insulating finish was used on cargo vessels during the war to protect the efficiency of vital deck motors

G-E INSULATING FINISH 1201

Glyptal Red for Sealing and Protecting Insulated Surfaces



... and the same Glyptal Red is now in wide use to finish off induction motors in paper mills and other industrial plants.

GENERAL ELECTRIC has long been a leader in the field of scientific insulation. Better insulation had to come before each forward step of the electrical industry. When you specify G-E Insulating Varnishes, you invest in 45 years of experience ... uniformity assured by G-E Quality Control ... expert advice on any kind of application. For details consult your local G-E Merchandise Distributor. Or write direct to Section RIMA-1265, Resin and Insulation Materials Division, Chemical Department, General Electric Company, Schenectady 5, N. Y.

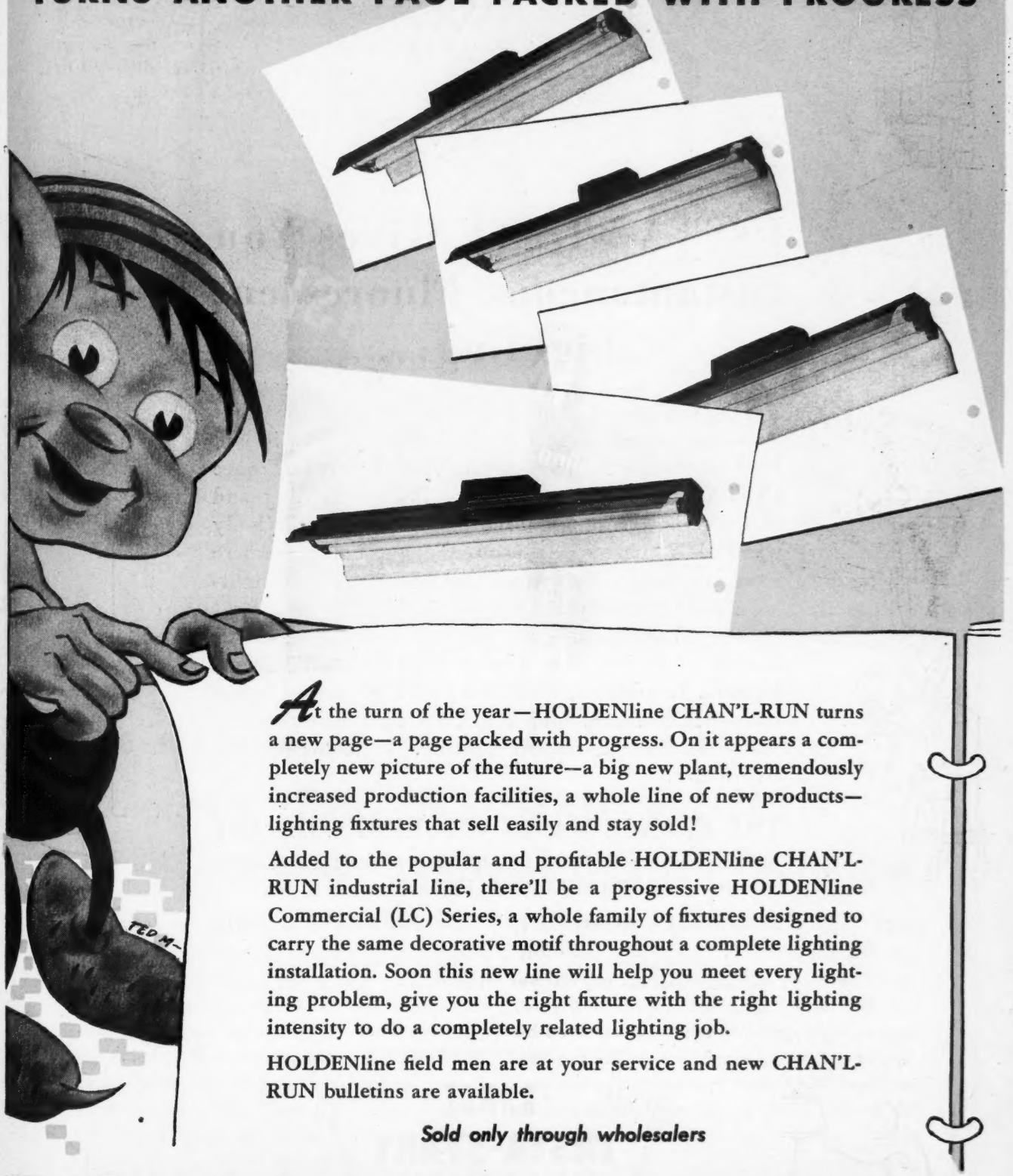
GENERAL ELECTRIC

CD46-17

G. E. OFFERS A COMPLETE LINE OF INSULATING MATERIALS

HOLDENLINE CHAN'L-RUN

TURNS ANOTHER PAGE PACKED WITH PROGRESS



At the turn of the year—HOLDENline CHAN'L-RUN turns a new page—a page packed with progress. On it appears a completely new picture of the future—a big new plant, tremendously increased production facilities, a whole line of new products—lighting fixtures that sell easily and stay sold!

Added to the popular and profitable HOLDENline CHAN'L-RUN industrial line, there'll be a progressive HOLDENline Commercial (LC) Series, a whole family of fixtures designed to carry the same decorative motif throughout a complete lighting installation. Soon this new line will help you meet every lighting problem, give you the right fixture with the right lighting intensity to do a completely related lighting job.

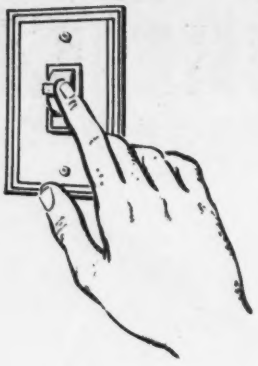
HOLDENline field men are at your service and new CHAN'L-RUN bulletins are available.

Sold only through wholesalers

HOLDENLINE COMPANY

Pioneers in Fluorescent

2301 SCRANTON ROAD • CLEVELAND 13, OHIO



INSTA-START Gives You Instantaneous Fluorescent Lighting...

FOR millions of Americans the flick of the light switch means light instantly. They expect it and react accordingly. Fluorescent lighting with France INSTA-START Transformer is instant lighting and therefore modern and efficient. That's what everybody wants. It's safe too — especially in the home — where more accidents happen than anywhere else, and lighting should promote, not hinder, safety.

Delayed or fumbling starting is a wholly unnecessary hazard — eliminated by France INSTA-START Transformers. In addition INSTA-START gives you better lamp performance, longer life, reduced maintenance, really modern fluorescent lighting. Write for descriptive folder.

THE FRANCE MANUFACTURING COMPANY

Manufacturers of INSTA-START Fluorescent Transformers and FRANCEFORMERS for Neon Signs

10325 BEREA ROAD CLEVELAND 2, OHIO

Armstrong Control Co., 8816 S. E. 17th St., Portland 2, Oregon
Allanson Armature Mfg. Co., Ltd., 21 McCaul St., Toronto 28, Canada

FRANCE
INSTA-START
REG. U. S. PAT. OFF.
TRANSFORMER
•
The Keystone of Fluorescent Lighting

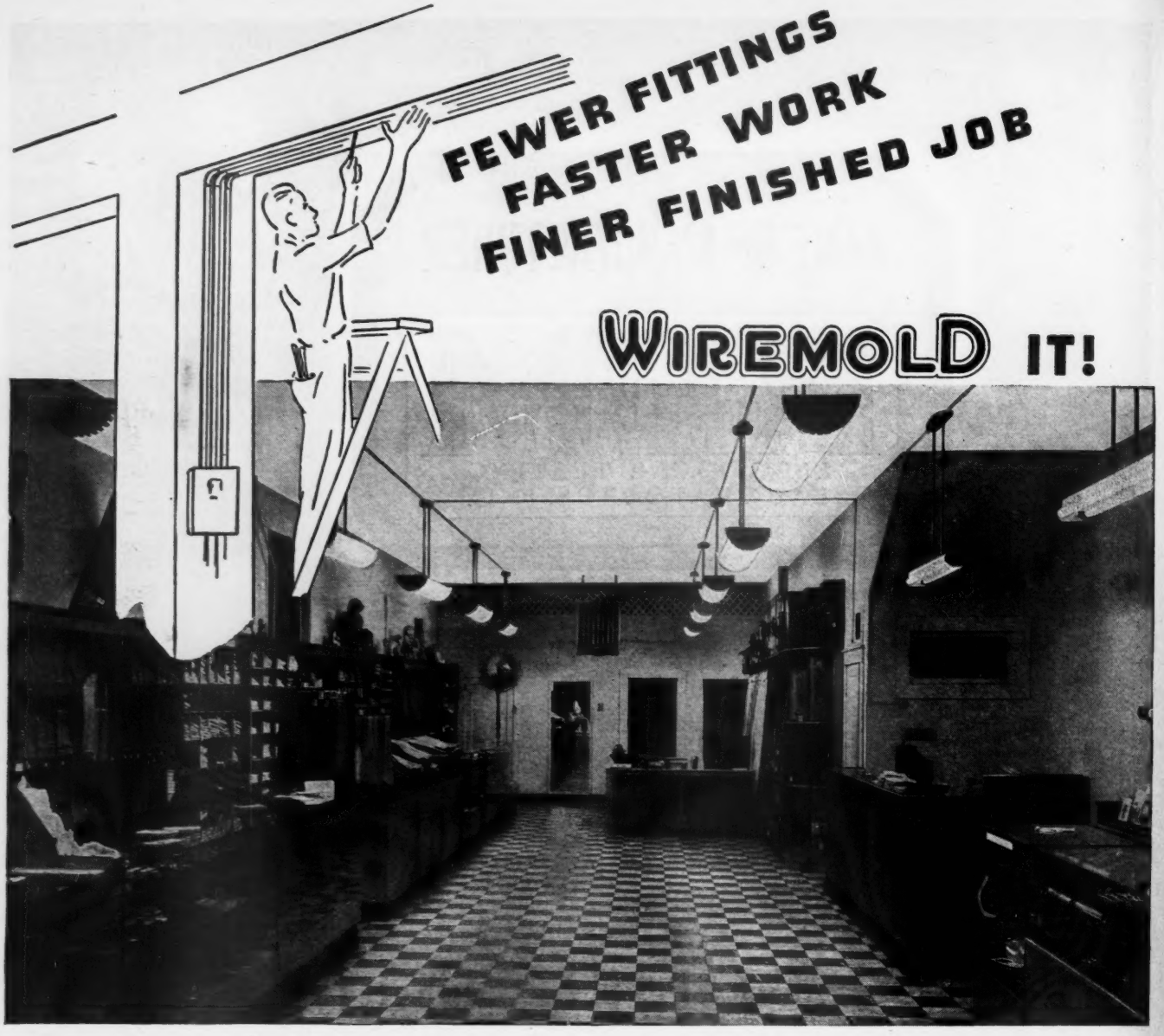
The meaning of the **RLM** label to *BUYERS....SPECIFIERS....SELLERS* of Industrial Lighting Equipment

This RLM Label affixed to an industrial lighting unit certifies that the unit has been manufactured to conform to RLM rigid specifications. RLM Specifications are drafted by a Technical Committee, guided by the findings of the *Illuminating Engineering* Society, the recommendations of the *Better Light—Better Sight Bureau,* and other recognized industry associations. These factors that provide (1) *Economy through more* Light at No Extra Cost, (2) Low Maintenance Cost and Long Life.

Whether you buy or sell industrial lighting, play safe by specifying lighting equipment built to conform to up-to-the-minute RLM Specifications and bearing the RLM Label. Copies of all the latest RLM Specifications may be secured through any manufacturer using RLM inspection and certification service, or direct from RLM Standards Institute.

RLM STANDARDS INSTITUTE

307 N. MICHIGAN AVENUE SUITE 420 CHICAGO 1, ILLINOIS



Work with Wiremold goes faster because one cut takes care of both cover and base and the raceway goes up in one piece. With every elbow and fitting a pull-box, wires are easily fished. Quick, positive slip joints and snap-on fitting covers all contribute to fast, accurate work without special tools of any kind.

Even on typical industrial type ceilings and walls with many beams and pillars, Wiremold fittings eliminate all makeshift bending, provide a clean, good-looking finished job.

The Wiremold Holecutting Tool which adapts all standard canopies to Wiremold raceway is available on loan. Write for details.

Surface Raceway Wiring . . . the WIREMOLD WAY . . . is your logical answer to today's urgent need for wiring ADEQUACY . . . easy to install . . . strong and safe . . . rated "tops" in performance for more than a quarter century.

Write us at once if you do not have a WIREMOLD WIRING GUIDE. A new one is in course of preparation.

THE WIREMOLD COMPANY
HARTFORD 10, CONN.

Know your WIREMOLD

NEMA

. . . . MORE THAN ADEQUATE WIRING

FROM PANEL BOX TO OUTLETS

All-bright

"RIGHT LIGHT" Installations

SELECTED for SELLING

Modern, fluorescent, lighting installations planned by ALL-BRIGHT to harmonize with the architectural design of display room interiors, to merchandise effectively and to provide efficient illumination for the entire area.

—Photographs *(Above, left)*—A radio and electrical appliance display of Admiral Corporation with surface mounted "Skylight" fixtures, the ultra in fluorescent lighting, Furniture Mart, Chicago, Illinois.

—*(Above, right)*—An automobile salesroom illuminated by continuous runs of ALL-BRIGHT, custom built, fluorescent, louvered, recessed (REC) fixtures for "right lighting" and striking display.

—*(Left)*—The Riback Pharmacy with ALL-BRIGHT REC, fluorescent, louvered luminaires installed

LIGHT RIGHT WITH ALL-BRIGHT

All-bright ELECTRIC PRODUCTS COMPANY

Manufacturers of Fluorescent Lighting Fixtures

3917-25 North Kedzie Avenue Chicago 18, Illinois

BURNDY

HYLUGS

Connect electric wires and cables **faster . . . better . . .** *with* ***HYDENT*** *(indent type)* ***connectors.*** *One-piece, pure-copper, heavy walled construction assures high-strength, low-resistance connections. Quickly installed with manual* ***HYTOOLS,*** *or high-speed pneumatic and hydraulic* ***HYPRESSES.*** *In all types for conductors from #22 to 2000 Mcm. See your Burndy representative, or write . . .*

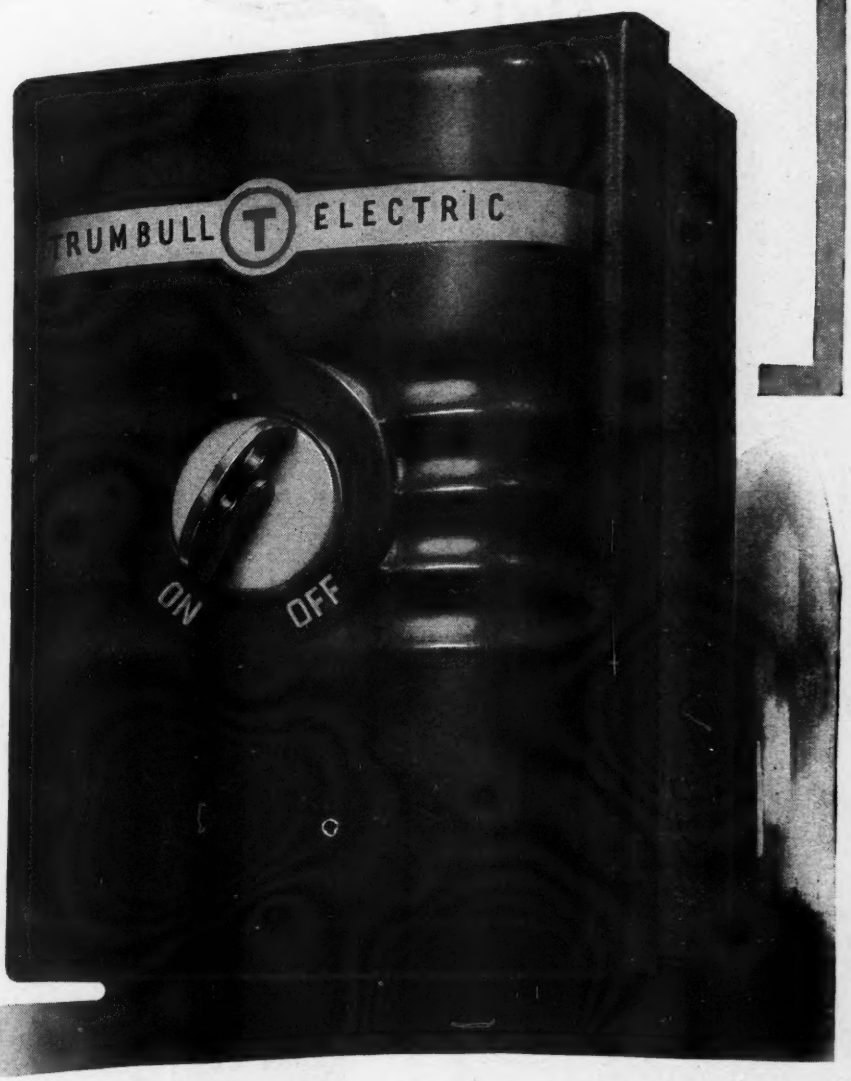
BURNDY . . . New York 54, N. Y.

In Canada: Canadian Line Materials, Limited, Toronto 13
Foreign: Philips Export Corp., New York 17, N. Y.

"LET'S TAKE THE SIMPLE, INEXPENSIVE TYPE D SWITCH··AND MAKE IT BETTER THAN IT HAS EVER BEEN MADE BEFORE"

In just those words more than a year ago, a Trumbull team of design and production engineers set to work to give the Electrical Industry's basic low-cost enclosed switch "the works". How well they have succeeded is for YOU to decide. But we know in advance what your verdict must be. For, not only is this an outstanding example of American postwar ingenuity in making a product far superior in quality and performance at low cost . . . it is also the handsomest, simplest, most easily wired, sturdiest and best engineered Type D Switch you have seen . . . or we either.

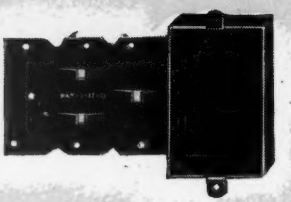
Now coming off our new streamlined production lines mighty fast. Place your orders, Gentlemen!



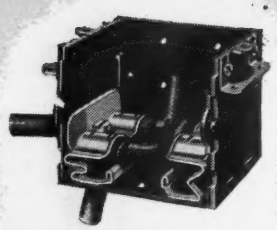
- *Front* operated.
- Locking provision in "off" position.
- Straight through wiring.
- Back mounted.
- More wiring space.
- Switch unit removable.
- Very compact.

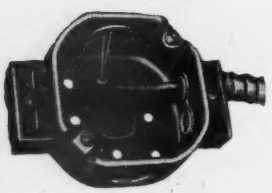
THE TRUMBULL ELECTRIC MANUFACTURING COMPANY
PLAINVILLE, CONNECTICUT
OTHER FACTORIES AT NORWOOD, OHIO • SAN FRANCISCO • LOS ANGELES • SEATTLE

You Can Always Rely on RACO!



RACO—
Switch Boxes
Outlet Boxes





• Architects, builders and electrical contractors the country over know that they "Can Always Rely on Raco." They know that 34 years' engineering experience backs up this quality line.

Get acquainted today with Raco All-Steel Products. You, too, will find that it's the *dependable* line, the *uniform* line, the *clean* line—no ragged or rough edges; attractively finished and packed in cartons.

Remember our slogan—its *your* assurance of a better line of steel switch and outlet boxes!

★ ***Many other types also available*** — A BOX FOR EVERY NEED

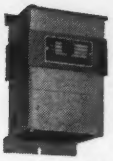
ALL-STEEL EQUIPMENT, INC.
600 Kensington Avenue
Aurora, Illinois

RACO
ALL-STEEL PRODUCTS

A Complete Line of Switch and Outlet Boxes

ALL-STEEL EQUIPMENT, INC.

SORGEL AIR-COOLED TRANSFORMERS



¼ KVA. Single Phase
460/230 to 115 volt.

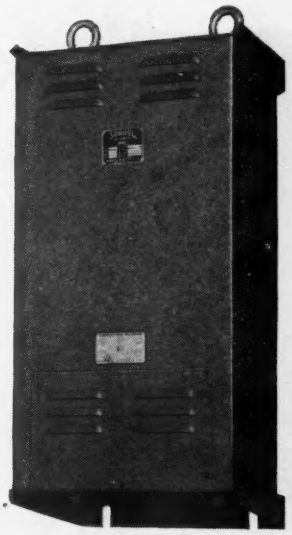
15 KVA, 3 phase,
Wall Mounting Type.

Large Variety of Sizes and Types

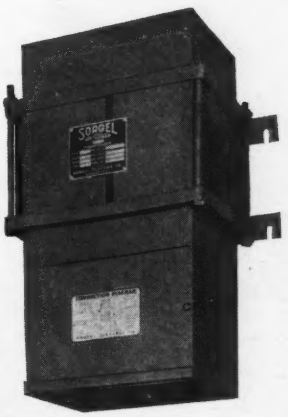
¼ to 1000 KVA. **All voltages up to 13,200.**

Insulating	Single phase
Auto	Poly-phase
Booster	Phase changing

Enclosed types for installations in buildings. Open types for assembly with other equipment. Standard voltages. Special voltages. Step-up or step-down.

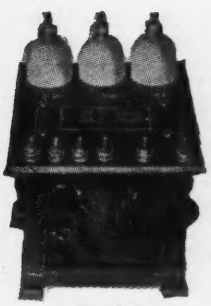


25 KVA, Single phase,
460/230 to 230/115 volt.
Wall Mounting Type.

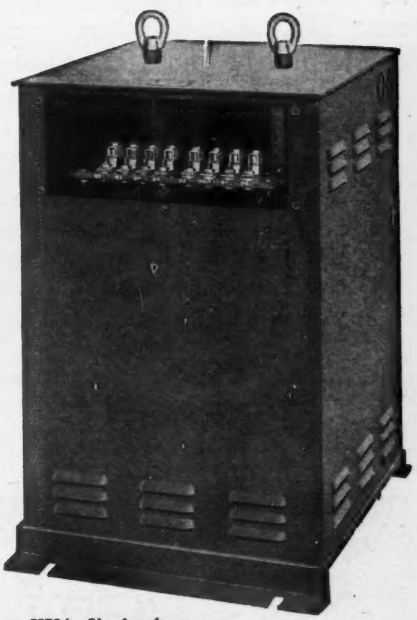


5 KVA,
Wall Mounting Type.

80 KVA, 3-phase.
6000/10400 Volt.
Induction Heating Transformer.



Special
Electronic Device
Transformer



50 KVA, Single phase,
Floor Mounting Type.
With cover of connection compartment removed showing solderless terminals.

SORGEL ELECTRIC CO., 836 W. National Ave., Milwaukee 4, Wisconsin

Pioneers in the development and manufacturing of Air-Cooled Transformers

Lifetime Accuracy

Price Reduced!

IDEAL Electrically Operated

TACHOMETER

Regardless of the job—time—or place, you can always depend upon the accuracy of an IDEAL Tachometer. In fact, accuracy is *guaranteed* to plus or minus 1% of full scale deflection.

Here is why:

1) Meter is rectifier type with D'Arsonval movement.
2) Movement is mounted on jeweled bearings.
3) Will take momentary overload up to four times.
4) The generator has Alnico permanent magnet rotor with grease sealed anti-friction bearings.
5) Tachometer may be operated continuously at any speed.
6) Generator separable from meter for "hard-to-reach-and-see" readings.

Everything offered in the finest speed-indicating instrument is included in the IDEAL Tachometer. Regardless of the job—on the production line, in the laboratory, or in general plant maintenance, the IDEAL Tachometer can be depended upon. Many users report that the cost has been saved on a single job.

The illustrations show the "hand type" with units coupled together and also with the units separated. This type may be used to read either RPM. or FPM.

A PANEL TYPE for permanent mounting is also available. Speed ranges up to 5,000 RPM.

PROMPT DELIVERY!

Distributed Through AMERICA'S LEADING WHOLESALERS

IDEAL INDUSTRIES, Inc.

(Successor to Ideal Commutator Dresser Co.)

2064

1041 PARK AVENUE • SYCAMORE, ILLINOIS

DECEMBER . . . . *at a Glance*

Radio Aerials

Small built-in loops and sensitive preamplifiers have made broadcast receivers independent of antenna systems. Apparently based upon this improvement, many apartment houses now under construction have no radio antenna systems, raceways or outlets. This is an expensive omission. The new sets will include FM, and television is on the way. Both operate in a frequency band where well designed and well located aerials are essential to effective operation. The radio people have muffed this one badly. It is high time they brought the electrical construction industry up to date on the aerial requirements of the new equipment. Raceways can't wait until the sets are on the market. They have got to be installed now.

Replacement Tubes

One of the minor problems of electrical maintenance today is the stocking and handling of replacement tubes for electronic apparatus and sound systems. Like lamps they take more care in handling than the usual run of materials, but unlike lamps, different tubes usually offer an almost identical appearance, requiring careful marking and keeping them in the original cartons. If you have worked out a practical scheme or system, the editor will welcome your ideas.

Brush Improvements

Out of the motor and generator problems of high altitude flying has come a chemical treatment for brushes that is helping to solve industrial brush and commutation difficulties. J. V. Dobson of Stackpole Carbon Company, who worked as coordinating engineer for Stackpole and Westinghouse on the development, describes the application of chemically treated brushes in the article "Treated Brushes" on Page 64. Incidentally our cover this month is a shot of a large commutator to which the new brushes have been applied.

Planned Expansion

A well developed long range wiring plan is a useful and economical tool where frequent changes and additions call for many small wiring jobs. At the Garlock Packing Co. in Palmyra, N. Y., the T. H. Green Electric Co. has worked within such a plan in the reconversion and expansion of the electrical wiring system. You'll find the story on Page 60.

Modern Approach

Three authorities on store lighting practice were given a basic store plan and requested to report their lighting recommendations to an IES technical forum. Out of their reports come a wide range of good lighting methods that can be applied to many projects now in the planning stage. You'll find "3 Lighting Layouts for a Store" on Page 54 packed with sound and practical ideas.

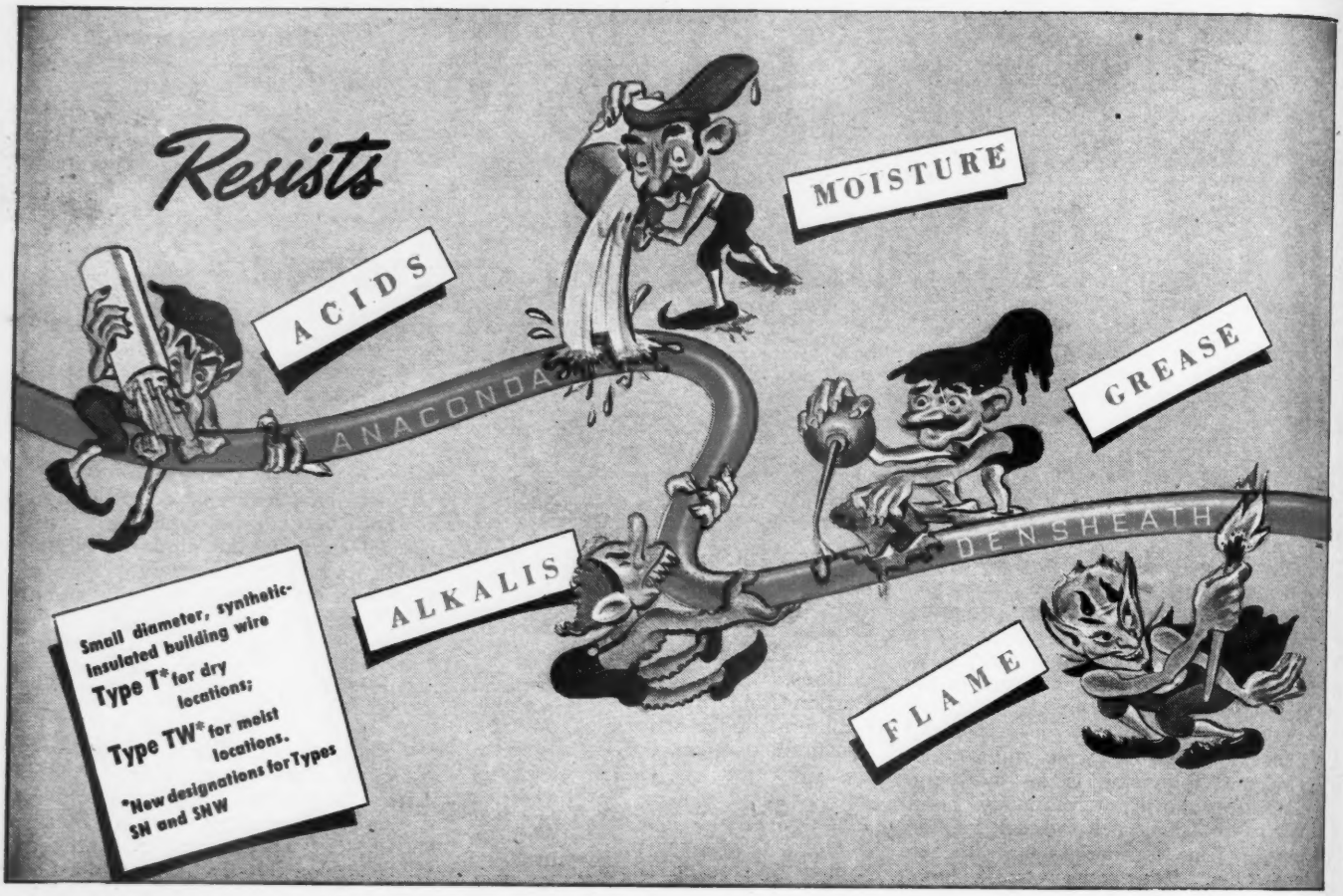
Phase Shift

Economical changeover from two to three phase in a working plant calls for astute engineering. A unique system, developed by Sweningson Co. of Chicago and named the "Carlson System" after Chief Engineer W. L. Carlson, who worked it out, is described in "Multiphase Distribution" on Page 51. We usually steer clear of complex mathematics and vector analysis but, figuring that many will want the analytic background of this important development, we have included the vector data with this article.

Gasoline Competition

A lot of farm equipment can be operated by either electric motors or gasoline engines. And the choice is going to the most quickly available drive. The tremendous industrial demand is seriously handicapping the electric motor in the race. Sound policy would dictate a larger allotment of available motors to the rural areas for farm electrification. And such a policy now will be paying big dividends to all the industry for years to come.

Proven under the most severe conditions— it's the outstanding wire for your normal needs



Densheath* TYPE T & TW BUILDING WIRE

*Reg. U. S. Pat. Off.

REMARKABLE DURABILITY—A synthetic insulating compound of extremely dense formation. Smooth, polished finish.

HIGH RESISTANCE—To moisture, acids, alkalis, chemicals; mineral, animal and vegetable oils.

FLAMEPROOF—Will not ignite, burn or support combustion.

UNUSUALLY PLIANT—Has no "spring"; retains any bend.

TENSILE STRENGTH AND ELONGATION—Similar to values found in rubber compounds.

SUPER-AGING—Superior to any rubber compound in resisting ozone, oxygen and sunlight.

DIELECTRIC STRENGTH—Superior to that of usual grades of rubber insulation. Good resistance; low specific inductive capacity.

MORE CIRCUITS PER CONDUIT—For new installations, extensions and maintenance.

ABRASION, TEARING, BENDING, FLEXING—Resistance in keeping with other qualities.

STRIPS EASILY—Leaves bright conductor.

EASY IDENTIFICATION—Conveniently marked.

Wherever single or multiple control cables are open to severe conditions, Densheath also gets the call—for example, in wiring machine tools, equipment in acid treating plants, chemical plants. Can be had in a range of colors. Anaconda Wire & Cable Company, Subsidiary of Anaconda Copper Mining Company, 25 Broadway, New York 4, N. Y. Sales Offices in Principal Cities.

ANACONDA **ANACONDA WIRE & CABLE COMPANY**

THE NEW CODE

THE 1947 REVISION of the National Electrical Code will be available within a few weeks. It is the first formal revision since 1940. During the war changes were made by "interim revisions", most of them temporary, to meet the extraordinary conditions of that time.

THE NEW CODE has been many months in preparation. Its rules have been carefully appraised and reviewed by representative bodies from all segments of the industry. A great many men have given generously of their time and wisdom to its preparation. It is a mature, carefully considered work that we can accept and apply with confidence.

THERE ARE FEW BASIC CHANGES. The rules are much the same as previous for typical wiring jobs. Important new rules have been added, however, pertaining to types of wiring and equipment that were stimulated by war production. Among these are rules for fluorescent lighting, high voltage lighting installations and welding equipment.

THE NEW RULES for hazardous area wiring, completely revised, are of particular importance since many new industrial processes involve materials, solvents and gases of a combustible nature. And in house wiring there are new branch circuits more adaptable to the types of utilization equipment coming on the market.

BY AND LARGE, the new Code is conservative, practical and geared up to the tempo of the industry today. But to be effective in protecting the public against electrical hazards it must be intelligently and conscientiously applied and ably enforced.

IT IS THE INDIVIDUAL responsibility of everyone in the industry concerned with design, installation, repair and maintenance to be thoroughly informed on the new Code. A number of industry groups are already organizing classes and study groups. There ought to be many more.

THE CODE is often made a part of local and state codes and enforced by public authorities, usually men of long industry experience. If we want able enforcement the electrical inspector must be well qualified and enjoy the confidence and respect of the industry. To get and keep such men requires compensation at a scale commensurate with the duties and responsibilities. And this is an industry responsibility.

Wm. F. Stuart

which of these TOOLS do YOU use?

Here's an authentic list of the tools that are commonly used by electrical contractors today. By checking your stock of tools against this list, you can see how well equipped you are to handle a full range of electrical installations.

As you know, possession of all the right tools for each job is a big help toward getting the job done properly and quickly. Moreover, the best equipped contractor is the one most likely to get the biggest contracts.

Graybar — time-saving source of all the apparatus and supplies you install — is an equally convenient source of the specialized tools you need to install them. Probably nowhere else can you get so complete an electrical supply service as Graybar offers. Our nation-wide warehousing system speeds delivery of available items — and the Graybar Specialists near you are always ready to lend a helping hand in selecting and applying the best equipment, supplies, and tools for each job. *Graybar Electric Company. Executive offices: Graybar Building, New York 17, N. Y.*

4642

ELECTRICAL CONTRACTORS' TOOLS

(from a list furnished by Electrical Contractors Association of Chicago)

- Benches — Large
- Benches — Small
- Vises — ½" to 2"
- Vises — 2" to 4"
- Thread Cutter — Pr. Dr.
- √ Bender — Small
- √ Bender — Large
- √ Hickies (H. W. C.) — ½" & ¾"
- √ Hickies (H. W. C.) — 1"
- √ Thin-Wall Bender — ½"
- √ Thin-Wall Bender — ¾"
- √ Thin-Wall Bender — 1"
- Chain Tongs — 1½" — 2½"
- Chain Tongs — 2½" — 4"
- Reamers ½" — 1¼"
- Reamers ½" — 3"
- Oilers
- Drill Press
- Power Saw — Univ. Band
- √ Copper Bender
- √ Iron Bender — Univ.
- √ Tool Grinder — Elect.
- Work Bench
- Machinist Vise
- Forge
- Anvil
- √ Tool Boxes — Steel
- Tool Boxes — Wood
- Chains & Locks — Ladder
- √ Ladders — Step 6 ft.
- √ Ladders — Step 8 ft.
- √ Ladders — Step 10 ft.
- √ Ladders — Step 12 ft.
- √ Ladders — Step 14 ft.
- √ Ladders — Step 16 ft.
- √ Ladders — Exten.
- Scaffolding Mat.
- Tool Grinders — Hand
- √ Electric Drills — ¼"
- √ Electric Drills — ½"
- √ Drills — Twist, Misc.
- Taps — Misc.
- Whitney Punches & Dies
- √ K. O. Punches — Sets
- Air Hammers
- √ Electric Hammers No. 2
- √ Electric Hammers No. 4
- Reamers — Misc.
- Files — Misc.
- √ Star Drills
- √ Hacksaw Blades
- Bullpoints — Misc.
- Pinch Bars
- Socket Wrenches
- Bolt Stock & Die Set
- √ Exten. Cords
- √ Burners & Tanks — Gas
- √ Coffing Hoists
- √ Chain Hoist — 5 Ton
- √ Rope — Hemp ½"
- √ Rope — Hemp ¾"
- √ Blocks — Snatch & Misc.
- Wagon Trucks
- Dollies
- Jacks — Stone
- Sledges & Hammers
- Chain — Coil
- Carpenter Tools
- √ Fish Tape 100' — ⅛"
- √ Fish Tape 100'—3/16"
- √ Fish Tape 200' — ¼"
- √ Winches — Hand Dr.
- √ Winches — Power Dr.
- √ Power Drive — Univ.
- √ Wire Rope 150' — ¼"
- √ Wire Rope 200' — ⅜"
- √ Cable Pullers
- √ Reel Jacks
- √ Pick-up Cart
- √ Brake — Cable
- √ Reels — Pay-out
- √ Reels & Stand — Gang
- √ Strippers — Wire
- √ Gas Furnaces
- √ Elect. Soldering Set
- Steel Lettering Set
- Floor Crane
- Air Compressor
- √ Elect. Welder
- Flex. Shaft Grinder El.
- Rolling Scaffold
- √ Stocks & Dies

√ You can get these via Graybar

FREE — *Have you seen the "John Watts" booklet? If not, be sure to call or write us for a copy. It's all about you, and we think you'll find it interesting.*

ADEQUATE WIRING SERVES AND SAVES — THE KEY TO THE HOME OF TOMORROW

IN OVER 90 PRINCIPAL CITIES

Everything for Electrical Contractors via **GraybaR**

MULTIPLE-PHASE DISTRIBUTION

How the "Carlson System" provides economical dual service during a gradual shift from two-phase to three-phase operation at Sherwin-Williams Chicago plant. Single transformer bank serves both distribution circuits.

By Oscar Sweningson
President, Sweningson & Co.
Electrical Contractors & Engineers
Chicago, Illinois

O. Sweningson (left) and his chief engineer W. L. Carlson check their 2-phase and 3-phase, 5-wire distribution scheme. Both are graduate and registered professional engineers. Carlson holds degrees in electricaal engineering and mathematics from Norway, Sweden and Germany.

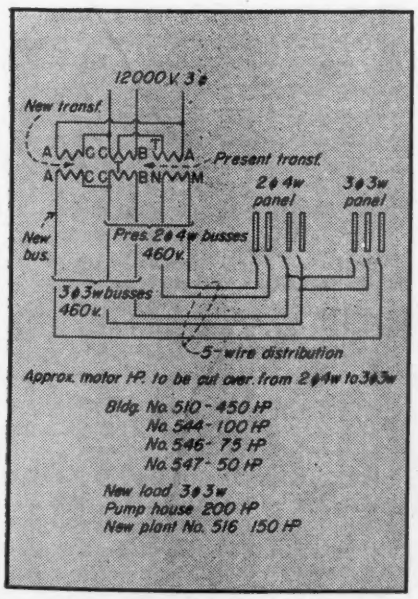

12000 V. 3 ø
New transf.
A C C B T A
Present transf.
A C C B N M
2 ø 4w panel
3 ø 3w panel
New bus
Pres. 2 ø 4w busses 460 v.
3 ø 3w busses 460 v.
5-wire distribution
Approx. motor HP. to be cut over from 2 ø 4w to 3 ø 3w
Bldg. No. 510 - 450 HP
No. 544 - 100 HP
No. 546 - 75 HP
No. 547 - 50 HP
New load 3 ø 3w
Pump house 200 HP
New plant No. 516 150 HP

Fig. A—A Single bank of three transformers and a five-wire feeder provides combined 2-phase and 3-phase distribution.

FOR some time the Sherwin Williams Company's Roseland Plant in Chicago has been operating under the increasingly difficult handicap of its original two-phase, four-wire, 440-volt power distribution system. The problem recently was brought to a head by inability to readily secure two-phase replacement motors and starting equipment; the lack of standard two-phase explosion-proof control equipment (nature of products require Class I, Group D equipment); and the desire to improve power factor and install 3-phase generating facilities. In the past, three-phase replacement equipment was connected to the two-phase distribution through phase changers, involving additional electrical losses. Management decided to gradually convert the entire plant to three-phase while maintaining production and existing equipment.

What was the most economical method of accomplishing this objective? Our firm (Sweningson and Company) was asked to make an analysis of the problem in collaboration with Sherwin-Williams' chief engineer R. D. McIntosh and W. A. Miller, general manager of all Chicago plants. After a thorough engineering study of the situation, our chief engineer, W. L. Carlson, developed a scheme that would supply both two-phase and three-phase motors from the same power feeders with a minimum of added transformer and feeder facilities. When complete conversion to three-phase was accomplished, present equipment could still be used and the system capacity enlarged.

For the purpose of identity, we will call this new scheme the "Carlson System" after the engineer who conceived it. Briefly, this scheme consists of adding one single-phase transformer AC (see Fig. A and Fig. 1) to each

of four existing Scott-connected transformer banks ranging in capacity from 600 kva. to 1800 kva. (primary, 12,000-volts, 3-phase; secondary, 480-volts, 2-phase, 4 wire). To each of the secondary, radial type, two-phase, four-wire underground feeders (four 500 MCM cables in fibre ducts) is added a single cable, making a five-wire secondary distribution system emanating from the transformer substations.

This connection, in effect, provides an open-delta, three-phase secondary while still maintaining the two-phase, four wire system. The middle transformer BC (see Fig. 1) carries both two-phase and three-phase loads.

Apparently this transformer combination had not been tried before, at least not in this area, so we had it analyzed and approved by the Commonwealth Edison Company (local utility). Their engineers, L. E. Ewald and Noble G. Larson, carefully analyzed the scheme and checked all calculations as did Ray W. Ashley, consulting electrical engineer and head of the Research Department, Electrical Contractors Association of City of Chicago. After final approval was received the changeover began.

Since the middle transformer BC carries the greatest current (handling both two-phase and three-phase loads) it is the limiting factor determining permissible loading of the new transformer bank. To ascertain the loading of various components of the circuit arrangement, a vector analysis was made.

It is evident that under the most unfavorable conditions the utilization factor of the transformer capacity is poor. This is partly due to the 87 per-

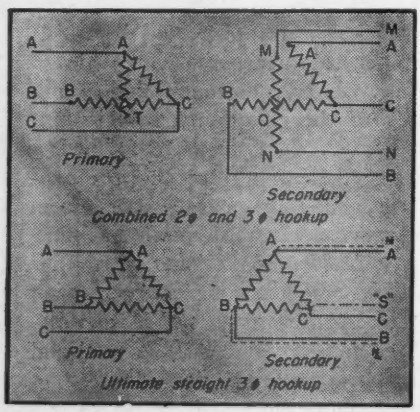


Fig. B—Comparison of the multiple-phase transformer hookup and the final connections of same equipment under straight 3-phase system. By adding cable "S" to latter hookup feeder capacity can be doubled.

cent utilization factor of both the Scott and Open Delta connections. However, this is only a temporary condition. When the cut-over is complete, the transformers will be connected Closed Delta giving 100 percent utilization.

Economies Effected

The combination two-phase and three-phase, five-wire distribution offered by the "Carlson System" is the most economical means of providing the necessary dual service, both from the standpoint of initial and operating costs. If a full three-phase distribution were installed to serve new equipment (in effect a parallel distribution system) it would require additional copper (three additional cables per feeder instead of one) and transformer facilities (two new transformers for open-delta instead of one).

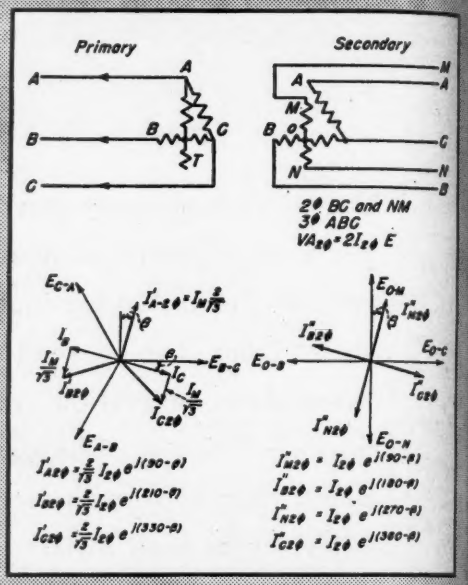
Wherever two-phase power exists at present, the same capacity of three-phase power can be obtained by simply adding *one* cable (same size) to the feeders already in use.

Under the new scheme, any two-phase motor can be quickly replaced by a three-phase unit and connected directly to the five-wire distribution. This eliminates the purchase of phase-changers and the dual electrical losses involved (at the transformer substation and phase-changer). Furthermore, should complete conversion of any plant area forge ahead of three-phase equipment delivery, the phase-changers formerly released from service can be used in reverse to supply any existing two-phase equipment from the new three-phase lines.

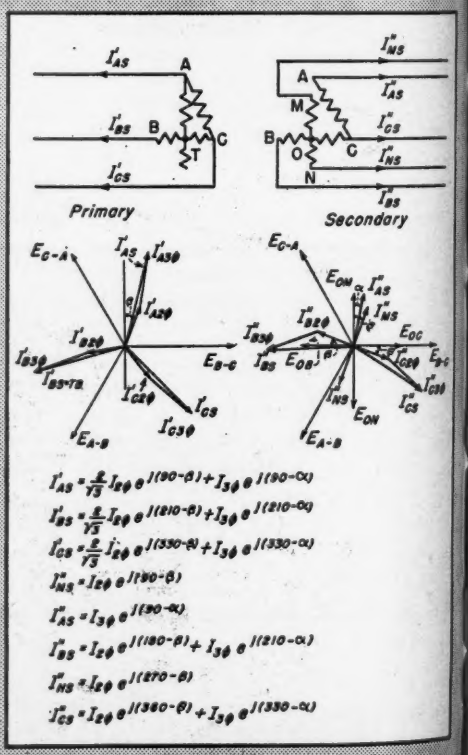
Having three-phase service available, the company will be in a position to purchase the necessary standard explosion-proof control equipment (required in numerous production areas) and standard electronic control equipment where applicable.

No transformer or feeder facilities need be scrapped when complete changeover to three-phase occurs. The transformers will merely be reconnected to form a closed delta-delta, three-phase system (Fig. B). The three-phase capacity of the transformer hookup, after complete conversion will be approximately 75 percent greater than that of the two-phase banks. Also, by adding one conductor to the five-wire feeder system (six wires, two conductors per phase), the feeder capacity can be doubled on a straight three-phase distribution.

Two Phase Load Only
(FIG. 1)



Combined Two Phase & Three Phase Loads
(FIG. 3)



For those interested in knowing how and why the scheme works (and those familiar with vector algebra and complex quantities), Carlson presents the vector diagrams in Figs. 1 to 4 inclusive.

Assuming balanced loads and one to one transformation, he applies the following reasoning to the vector diagrams and equations:

TWO PHASE LOAD ONLY (FIG. 1)—The secondary two phase load $VA_{2\phi} = 2I_{2\phi}E$ may be considered as two single phase loads with the currents $I_{2\phi}$ lagging behind the voltage at an angle of β degrees (power factor angle). The primary current in A is $\frac{2}{\sqrt{3}}$ times the secondary current $I_{2\phi}$. The primary current in B is obtained by adding half of the current in AB and the current in CB due to the two-phase load between secondary wires B and C. The primary current in C is obtained in the same manner.

THREE PHASE LOAD ONLY (FIG. 2)—The secondary three phase load $VA_{3\phi} = 3I_oE$ may be considered as three single phase loads with the current I_o lagging behind the voltage at an angle of α degrees (three phase power factor angle). The secondary currents in the line wires $I_{3\phi} = I_o\sqrt{3}$ are obtained by vectorially adding the load currents I_o in the respective wires. The primary currents are equal in magnitude and phase displacement to the secondary currents.

COMBINED LOADS (FIG. 3)—The vectors for line and transformer currents representing combined loads are obtained by adding vectorially the various two phase and three phase components.

RELATIONSHIP BETWEEN PHASE ANGLES AND LINE CURRENTS (FIG. 3)—The magnitude of the secondary line currents I''_{MS}, I''_{AS} and I''_{NS} are independent of the relationship between the phase angles α and β. The secondary line current I''_{BS} is a maximum for $\alpha-\beta=30°$, or when the three phase current lags 30 degrees behind the two phase current. The secondary line current I''_{CS} is a maximum for $\beta-\alpha=30°$, or when the two phase current lags 30 degrees behind the three phase current. The primary line currents are a maximum when $\alpha=\beta$ or the two phase and three phase currents are in phase. In no case do the line currents exceed the algebraic sum of $I_{2\phi}+I_{3\phi}$.

RELATIONSHIP BETWEEN PHASE ANGLES AND TRANSFORMER CURRENTS (FIG. 4)—The magnitude of the secondary transformer winding currents, OM, CA and ON are independent of the relationship between phase angles α and β. The secondary transformer winding currents OB and OC are maxima when $\alpha-\beta=30°$, or when the three phase current lags 30 degrees behind the two phase current. The magnitude of the primary transformer currents CA and TA are independent of the relationship between phase angles α and β. The primary transformer current TB is a maximum when α equals β, or when the two phase and three phase currents are in phase with one another. The primary transformer current TC is a maximum when $\alpha-\beta=60°$, or when the three phase current lags 60 degrees behind the two phase current. In no case do the transformer winding currents exceed the algebraic sum of the line currents.

With the transformer hookup as shown, the most unfavorable conditions occur when α is greater than β, that is when the power factor of the three phase load is lower than that of the two phase load. As all three phase loads will be in the form of new motors, it is important that selection of such motors be on the basis of maintaining the power factor as high as possible.

TRANSFORMER LOADING UNDER MOST UNFAVORABLE CONDITIONS—With the total capacity of the transformer bank = 3EI, the volt-ampere load will be:

Then: Volt-ampere load $= 2EI_{3\phi} + \sqrt{3}\,EI_{3\phi}$

Loading in percent "X" will be

$$X = \frac{2EI_{2\phi} + \sqrt{3}\,EI_{3\phi}}{3EI}$$

For the most unfavorable conditions, $I = I_{3\phi} + I_{2\phi}\frac{2}{\sqrt{3}}$

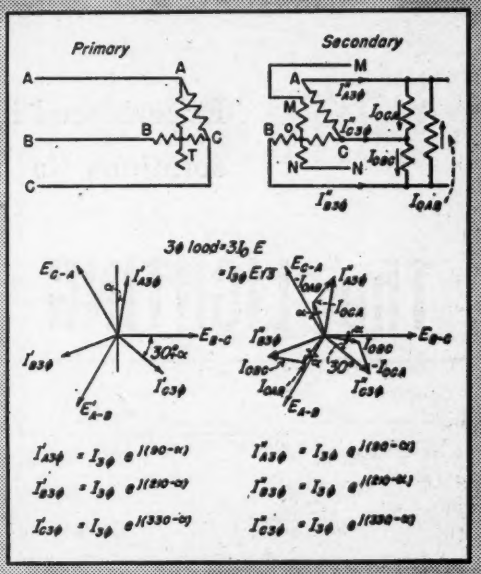
Then:

$$X = \frac{2I_{2\phi} + \sqrt{3}\left(I - I_{2\phi}\frac{2}{\sqrt{3}}\right)}{3I}$$

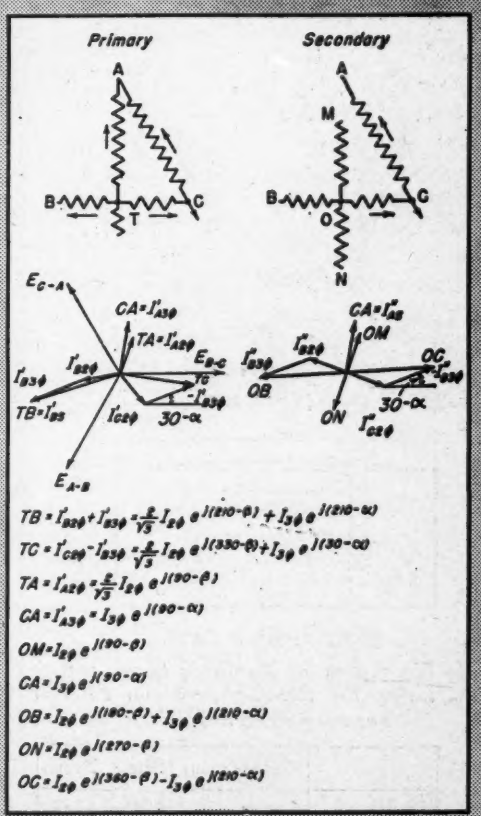
$$= \frac{2I_{2\phi} + \sqrt{3}\,I - 2I_{2\phi}}{3I}$$

$$= \frac{1}{\sqrt{3}} = 0.58$$

Three Phase Load Only (FIG. 2)



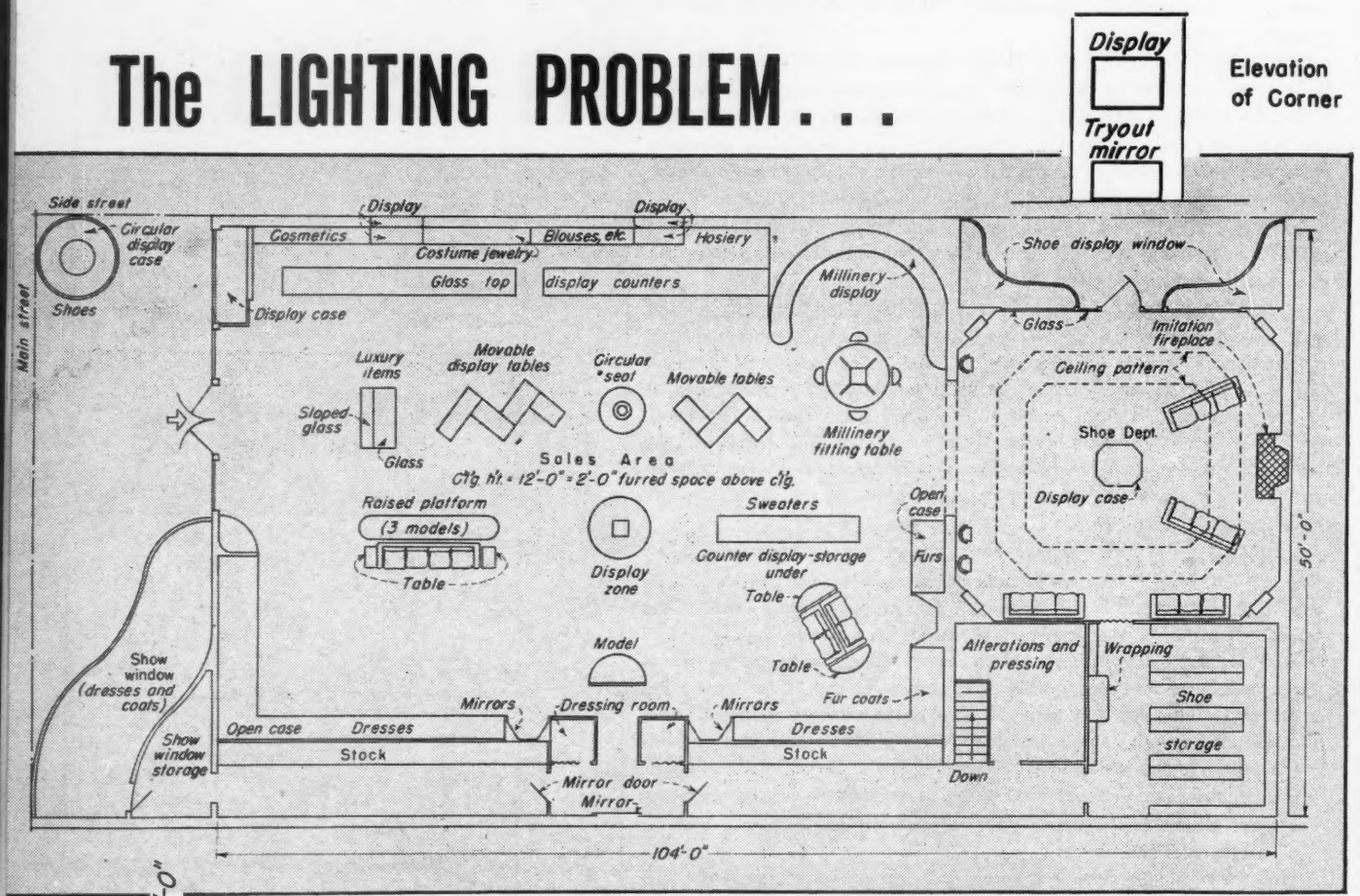
Combined Two Phase & Three Phase Transformer Winding Current (FIG. 4)

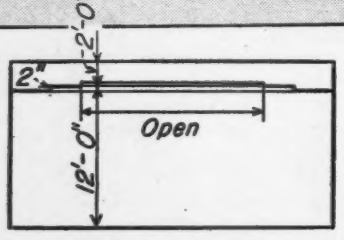

Primary
Secondary
TB = I'_B2φ + I'_B3φ = (2/√3) I_2φ e^j(210-β) + I_3φ e^j(210-α)
TC = I'_C2φ - I'_B3φ = (2/√3) I_2φ e^j(330-β) + I_3φ e^j(30-α)
TA = I'_A2φ = (2/√3) I_2φ e^j(90-β)
CA = I'_A3φ = I_3φ e^j(90-α)
OM = I_2φ e^j(90-β)
CA = I_3φ e^j(90-α)
OB = I_2φ e^j(150-β) + I_3φ e^j(210-α)
ON = I_2φ e^j(270-β)
OC = I_2φ e^j(360-β) - I_3φ e^j(210-α)

3 Lighting Layouts

Experienced illuminating engineers present separate solutions to a practical store lighting problem.

The LIGHTING PROBLEM . . .





Section – Shoe Dept.

Floor plan of Women's Shop, constituting the lighting problem. Interior finishes were given as follows:

	Sales area	Shoe Dept.
Walls	*Green*	*Light pink*
Ceiling	*Eggshell white*	*Eggshell white*
Floor	*Aqua green*	*Rose*
Display Fixtures	*Light birch*	*Walnut*

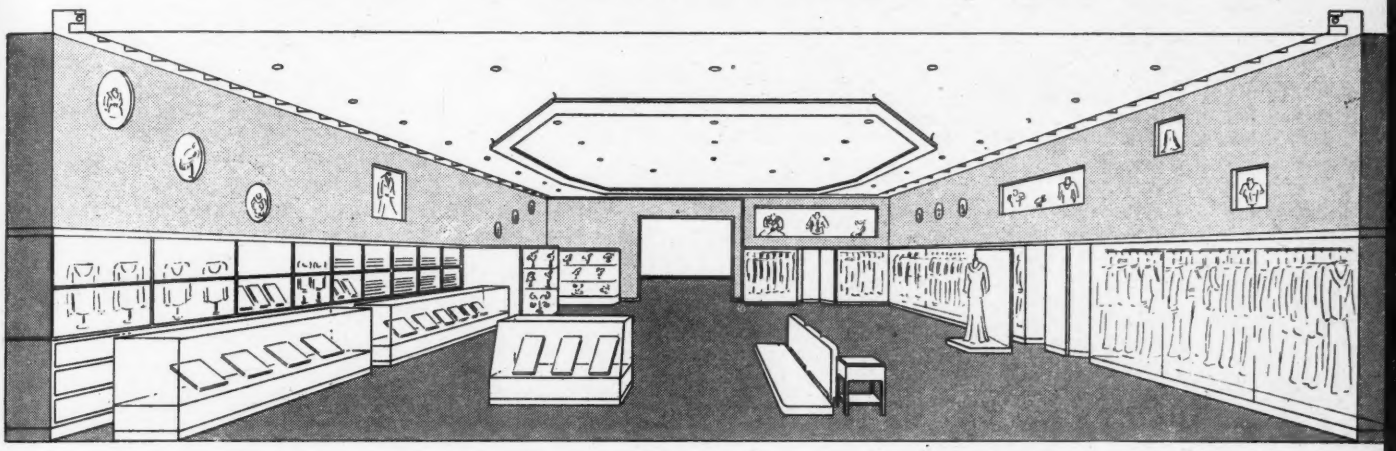
THREE *planned lighting* layouts, prepared by authorities on store lighting practice, are presented here in condensed form from a *Store Lighting Symposium* sponsored by the Technical Forum, New York Section, Illuminating Engineering Society. Each authority represents a different segment of the lighting industry. J. J. Flynn, Westinghouse Electric Corporation, Bloomfield, N. J. represented a lamp manufacturer; Bruce J. Jensen, Public Service Electric & Gas Company, Newark, N. Y., an electric utility; and Stanley McCandless, Century Lighting Company, New York, N. Y. and Associate Professor of Lighting, Yale University, a lighting equipment manufacturer.

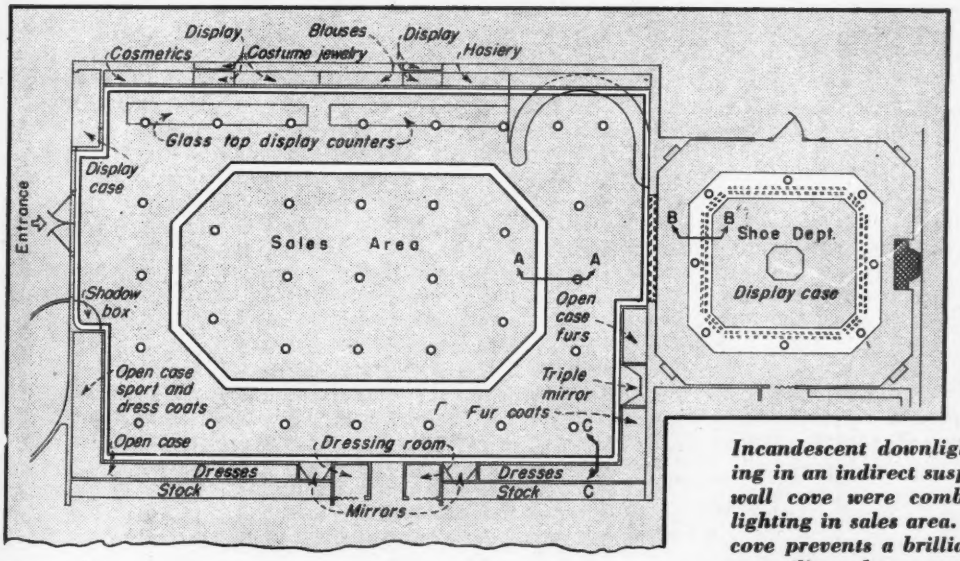
The problem consisted of planning the lighting for a Women's Shop, selling exclusive merchandise in a city of 75,000 to 150,000 population. Plans for this store, (see above), were given to each speaker in advance, to enable him to make his layout and prepare lantern slides. General alteration costs were given as $60,000 with an allowance of $10,000 for lighting equipment.

Analysis of the store plan shows lighting problems of the type encountered generally in many types of stores. Show window lighting was eliminated from the problem.

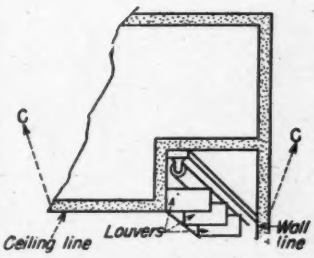
For a STORE

1...LAMP MANUFACTURER'S SOLUTION





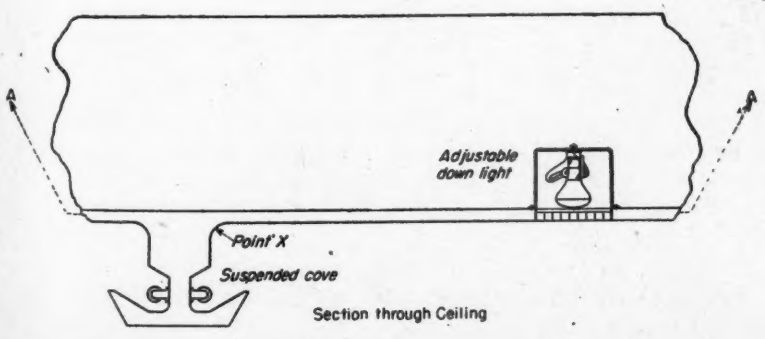
By J. J. Flynn



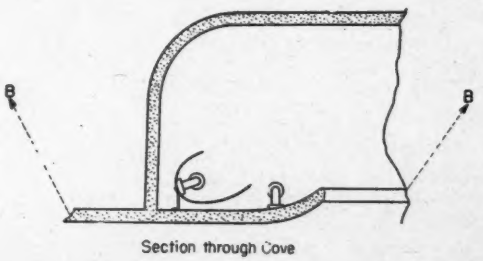
Section through Side Wall

Incandescent downlights and fluorescent lighting in an indirect suspended cove and a reverse wall cove were combined to provide general lighting in sales area. Design of the suspended cove prevents a brilliant "hot spot" at point X on ceiling above cove. Reverse cove provides light on dress racks and wall cases, enlivens wall areas. Jewelry and cosmetic counters are lighted by recessed downlights, which are also used to accent floor models and displays. Cove in Shoe Dept. is built into a furred ceiling.

Sections A-A, B-B and C-C show enlarged details of the lighting equipment.



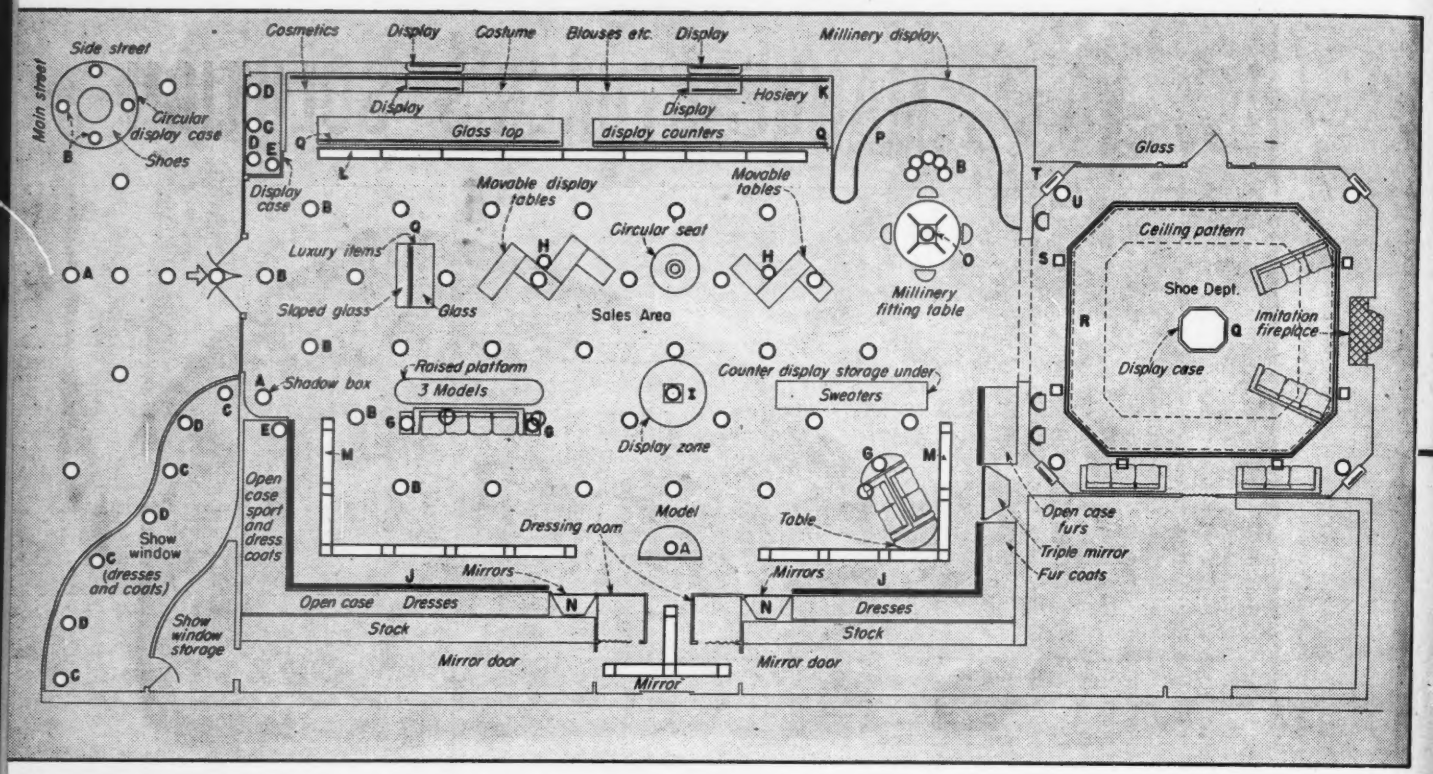
Section through Ceiling

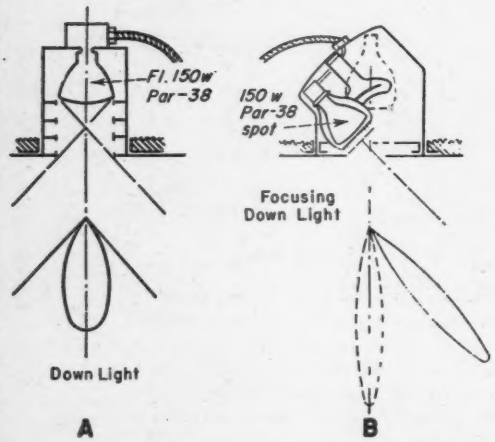


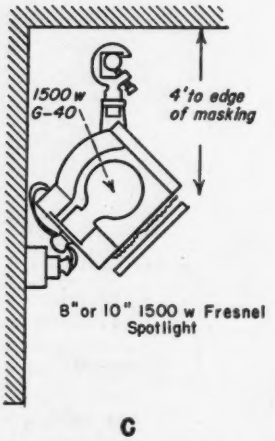
Section through Cove

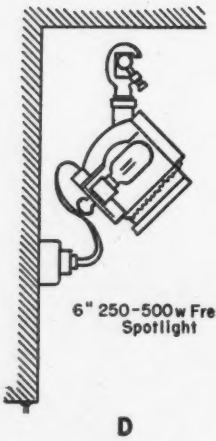
2...LIGHTING MANUFACTURER'S SOLUTION

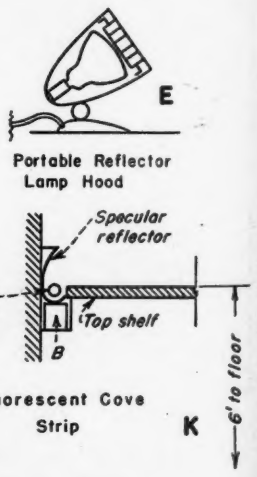
By Stanley McCandless

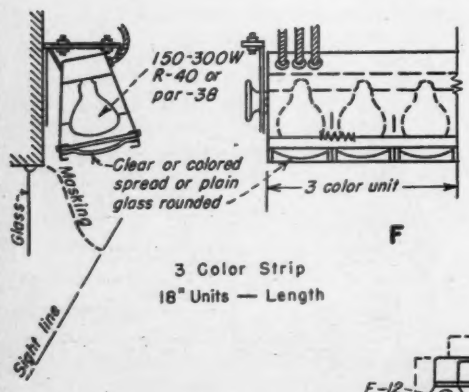


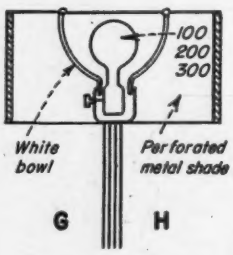


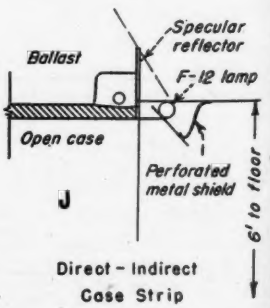


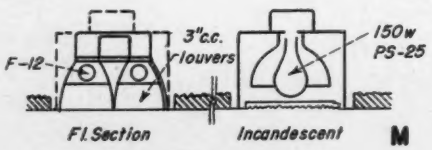


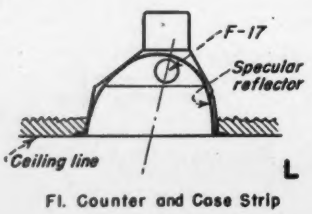


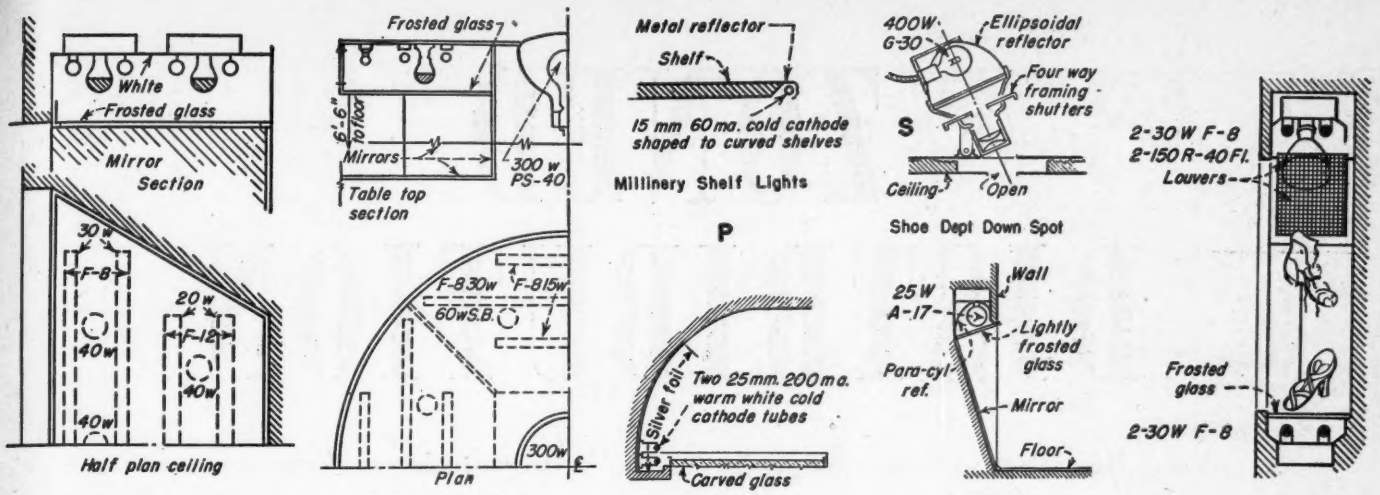








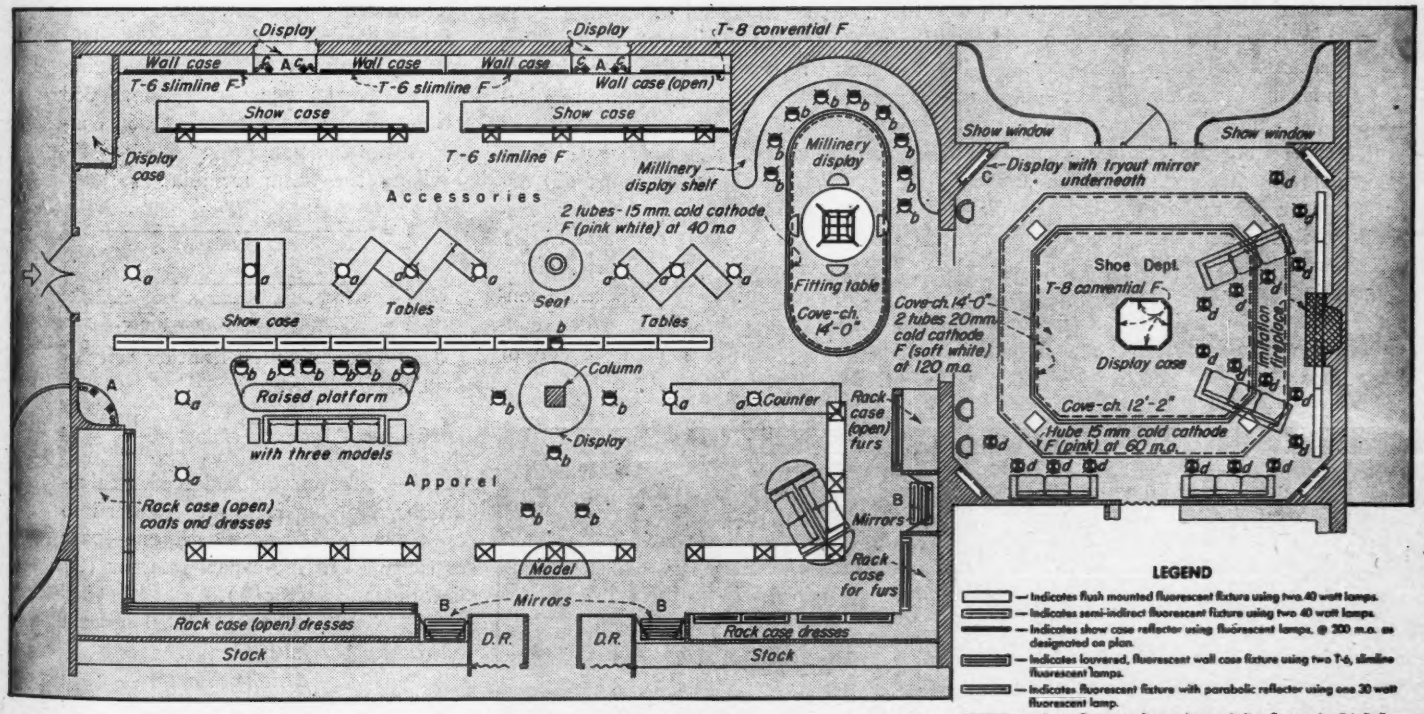




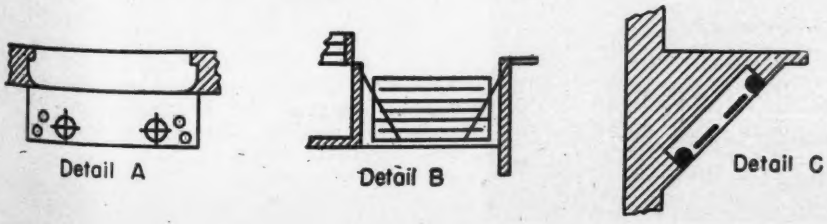
Emphasis is placed on accent lighting on merchandise in this solution. All light sources are well shielded, and all equipment is concealed from view. Intensities in aisles and circulation areas are kept low. Soft ceiling illumination is provided by floor and table lamps having indirect components, and by wall case two-direction reflectors.

3...ELECTRIC UTILITY SOLUTION

By Bruce J. Jensen


Display
Display
T-8 convential F
Wall case
Wall case
Wall case
Wall case (open)
T-6 slimline F
T-6 slimline F
Show case
Show case
T-6 slimline F
Display case
Millinery display
Millinery display shelf
Accessories
2 tubes-15 mm. cold cathode F (pink white) at 40 m.a
Show window
Show window
Display with tryout mirror underneath
Fitting table
Cove-ch. 14'-0"
Cove-ch. 14'-0" 2 tubes 20mm. cold cathode F (soft white) at 120 m.a.
Shoe Dept.
T-8 convential F
Show case
Tables
Seat
Tables
Column
Raised platform
with three models
Display
Counter
Rack case (open) furs
Apparel
Rock case (open) coats and dresses
Mirrors
Model
Rack case for furs
Mirrors
Rack case (open) dresses
D.R.
D.R.
Rack case dresses
Stock
Stock
Display case
Cove-ch. 12'-2"
Tube 15 mm. cold cathode F (pink) at 60 m.a.
LEGEND
— Indicates flush mounted fluorescent fixture using two 40 watt lamps.
— Indicates semi-indirect fluorescent fixture using two 40 watt lamps.
— Indicates show case reflector using fluorescent lamps, @ 300 m.a. as designated on plan.
— Indicates louvered, fluorescent wall case fixture using two T-6, slimline fluorescent lamps.
— Indicates fluorescent fixture with parabolic reflector using one 30 watt fluorescent lamp.
— Indicates fluorescent fixture with parabolic reflector using T-6 slimline fluorescent lamp and equipped with slightly frosted lumi-tile.
— Indicates asymmetric type fluorescent fixture, using 30 watt fluorescent lamp.
— Indicates cove equipped with cold cathode fluorescent tubing as indicated on plan.
— Indicates 30 watt fluorescent lamp.
— Indicates small cross-section light strip using 15 watt fluorescent lamp.
— Indicates flush mounted lens fixture using 300 watt filament lamp and suitable for continuous run installation with fluorescent fixture designated by symbol
— Indicates flush mounted lens fixture using 300 watt lamp.
— Indicates 25 watt, T-10, reflector lamp.
— Indicates flush mounted fixture using 300 watt filament lamp and equipped with concentric ring louvers.
— Indicates electrical outlet for 150 watt projector spot lamp equipped with semi-recessed, adjustable, ornamental housing.
— Indicates electrical outlet for 150 watt projector spot lamp equipped with adjustable housing and louvers.
— Indicates electrical outlet for 150 watt reflector spot lamp equipped with flush mounted fixture and concentric ring louvers.

All equipment used in this layout is of standard design. A continuous row semi-indirect fluorescent fixture furnishes general illumination and lights ceiling. Flush fluorescent and incandescent ceiling units provide high intensity light for selling. Cold cathode tubing is used in coves in millinery and shoe departments for general illumination and decorative effects. Lighting is provided for mirrors, floor and wall cases, dress racks and wall display niches.



ZONED DISTRIBUTION

Bus duct system design by "zone" computations. Ampere ratings translated into horsepower equivalents give customer clear picture of present loads and spare capacities.

By Leo W. Witz

Chicago, Illinois
Continental Electrical Construction Co.

ONCE electrical distribution is installed and in operation, there is a general tendency to make future additions without too much regard for maximum capacity of the system. To curb this, we employ a "zoned distribution" method of designing bus duct systems for industrial plants. All ampere ratings of the various system components are translated into horsepower equivalent, terms that the customer can readily comprehend. Each feeder and subfeeder of the installation is plainly labeled with its maximum capacity in *horsepower*. With this constant reminder, and knowing his connected load in horsepower, the owner can gage his electrical additions accordingly.

As implied, "zoned distribution" embodies division of the plant into electrical zones based on production areas or departments. Electrical system capacity is computed from the known present and anticipated future requirements.

All calculations include spare capacity, (1) fuse-capacity factor, (2) demand factor, (3) power factor, mechanical and electrical efficiencies. Thus, a comparison of only two quantities—maximum capacity and connected load—is necessary when contemplating additions to a feeder or circuit.

Design procedure as employed by our engineering department is as follows:

I—Divide the plant into electrical zones (see dotted lines of Fig. 1). Zone area depends on motor groupings.

II—Translate ampere capacity into horsepower equivalent. The specific project illustrated is a 3-phase, 440-volt system with motors averaging about five horsepower. Some 353 motors total approximately 2,368 connected horsepower.

Using the basic formula:

$$I = \frac{\text{h.p.} \times 746}{1.73 \times E \times \text{Eff. } (\%) \times \text{P.F.}}$$

$$I = \frac{1 \times 746}{1.73 \times 440 \times .85 \times .85}$$

$I = 1.35$ *amperes per horsepower*

III—Determine full limit capacity of duct in horsepower.

$$\text{H.p. per 100 amperes of duct} = \frac{100}{1.35} = 74$$

IV—Make circuit and feeder calculations, applying factors that enter into a plant distribution design—spare capacity (1), fuse-capacity factor (2) and demand factor (3).

(1) *Spare Capacity*—A 30 percent allowance for future loads.

(2) *Fuse-Capacity Factor* — Each duct must have a protective device to limit to a safe value the amount of current passing through the duct. Such a protective device, whether it be a fuse or circuit breaker, *should never be loaded beyond 70 percent of its rating.* Beyond such a point the excessive heat

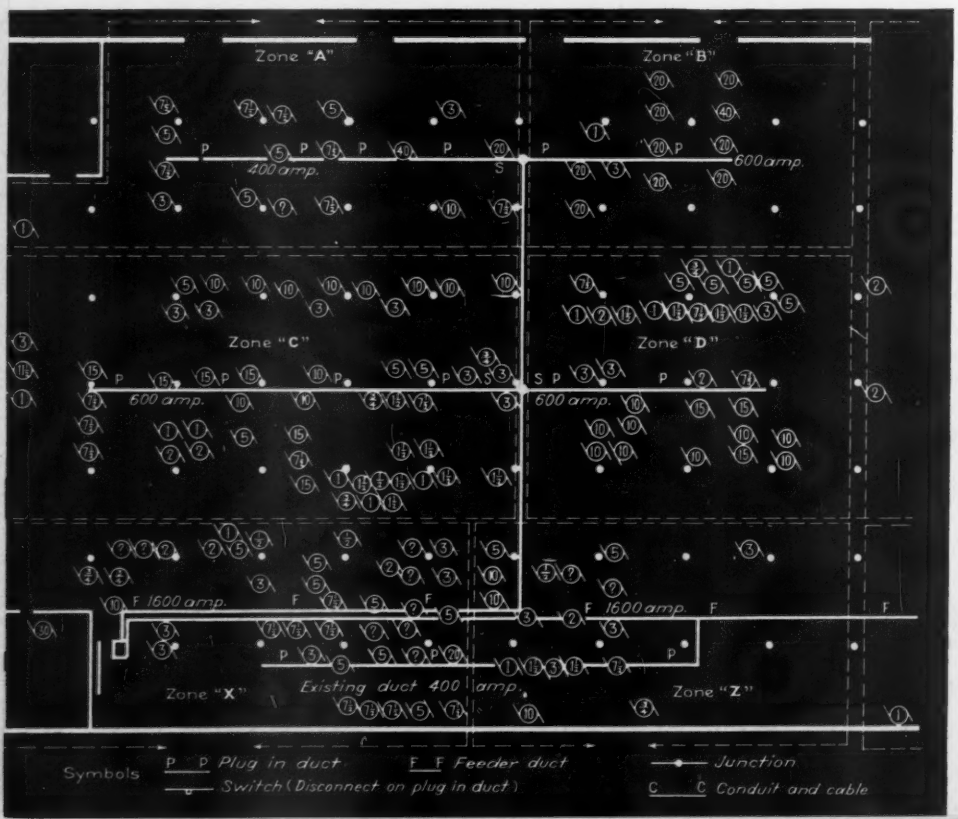


FIG. 1—Partial layout of a bus duct system designed by the "zoned distribution" method. Dotted lines designate electrical zones.

TABLE I
Initial Loading of Duct
(440-volt, 3-phase)

Duct Size	Maximum Loading	Less 30% Spare Capacity	Initial Loading
PLUG-IN DUCT			
250 Amp.	167 hp.	50 hp.	117 hp.
400 Amp.	268 hp.	80 hp.	188 hp.
600 Amp.	402 hp.	120 hp.	282 hp.
FEEDER DUCT			
800 Amp.	711 hp.	213 hp.	498 hp.
1000 Amp.	925 hp.	277 hp.	648 hp.
1600 Amp.	1539 hp.	462 hp.	1077 hp.

TABLE II
Recommended Plug-In Duct Sizes For Zone Distribution
(Based on Calculations Outlined)

Zone	Initial Zone Load—hp.	Recommended Duct Size—Amps.	Permissible Initial Duct Loading—hp.	Maximum Duct Loading—hp. (incl. spare capacity)
A	157	400 Amp.	188	268
B	224	600 Amp.	282	402
C	305	600 Amp.	282	402
D	201	600 Amp.	282	402
E	106	400 Amp.	188	268

Note: Other zones not listed to save space.

TABLE III
Recommended Feeder Duct Sizes
(Based on zone loads and duct capacities)

Feeder From	Feeder To	Feeding Zones	Total hp.	Recommended Duct Size (Amps.)	Permissible Initial Duct Loading	Maximum Duct Loading (incl. spare capacity)
Switchboard	Zones C, D	A, B, C, D	887	1600	1077 hp.	1539 hp.
Zones C, D	Zones A, B	A, B	381	800	498 hp.	711 hp.
Switchboard	Zones G, H	E, F1, F2, Z, G, H, J, K, L	1251	1600	1077 hp.	1539 hp.
Zones G, H	Zones E, F	E, F1, F2, K, L	823	1600	1077 hp.	1539 hp.
Zones E, F	Zones K, L	K, L	316	800	498 hp.	711 hp.

generated due to the resistance of the thermal device causes oxidation, loss of temper, increased resistance and frequent interruption of current. (NEMA Standards: Panelboard loads to Circuit Ratings Ration, pg. 10).

(3) *Demand Factor*—the ratio of the maximum power demand of any system or part of system to the total connected load of the system or that part of system under consideration.

Demand factors applied to this design are:

Circuit ducts (plug-in type)—80 percent

800 Ampere feeder ducts—80 percent

1000 Ampere feeder ducts—75 percent

1600 Ampere feeder ducts—70 percent.

(These figures represent the maximum percentage of the full load which will be in use at any given time.)

Maximum Capacity in Horsepower —per 100 Ampere Duct:

Equivalent horsepower of 100 ampere duct (Step II)	74 hp.
Less 30 percent (fuse-capacity factor)	
Plus 20 percent (demand factor)	
10 percent net deduction	7 hp. (approx.)
Maximum Capacity per 100 Amperes of duct	67 hp.

For standard duct sizes the maximum capacity (loading) of each will be:

200 Ampere plug-in duct — (67 × 2.5)	= 167 hp.
400 Ampere plug-in duct — (67 × 4.0)	= 268 hp.
600 Ampere plug-in duct — (67 × 6.0)	= 402 hp.

Initial Loading of Duct—is computed by subtracting the 30 percent allowance for future expansion from the maximum capacity of the duct (shown above in horsepower units). Results listed in Table 1.

Feeder duct capacities are computed in a similar manner. However, there are two significant exceptions: (1) The demand factor varies with the feeder size; and (2) the fuse-capacity factor is not applied because air breakers in these sizes are constructed with tolerances that permit handling full capacity of ratings.

Maximum Capacity in Horsepower—

800 Ampere Feeder Duct:	
Equivalent horsepower of rating (8 × 74)	= 592 hp.
Plus 20 percent (demand factor)	119 hp.
Maximum Capacity	= 711 hp.
1000 Ampere Feeder Duct:	
Equivalent horsepower of rating (10 × 74)	= 740 hp.
Plus 25 percent (demand factor)	185 hp.
Maximum Capacity	= 925 hp.
1600 Ampere Feeder Duct:	
Equivalent horsepower of rating (16 × 74)	= 1184 hp.
Plus 30 percent (demand factor)	335 hp.
Maximum Capacity	= 1539 hp.

Initial Loading calculations, like those for distribution duct, allow 30 percent for spare capacity. Values are shown in the bottom half of Table I.

V – Zone load determination in horsepower is next to the final step of the design method. A list of the individual motors in each zone is made and the total connected horsepower per zone computed therefrom.

VI—Final step leading to the actual distribution layout hinges on recommendations of standard duct sizes for the various component parts of the system. Actual duct capacity installed is based on a comparison table for both distribution and feeder circuits (Tables II and III).

The function of the engineer and contractor is to give the customer the best job possible for his investment.

With plans and specifications of this type on file, the owner has a clear picture of his complete electrical system—what it can do under present operation and just how far he can expand before taxing total system capacity. Should the analysis we submit be mislaid, the maximum horsepower capacity painted on each duct run provides a yardstick.

Wiring Follows

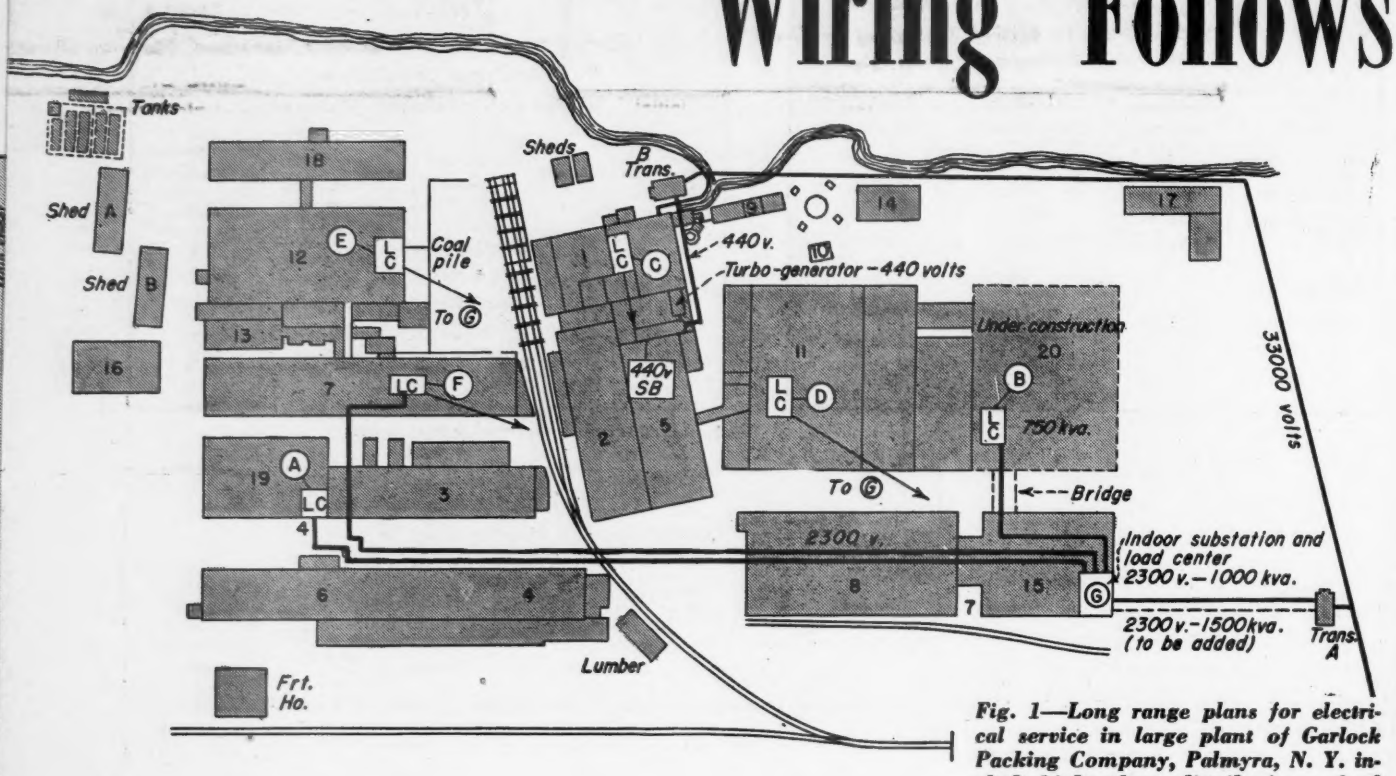
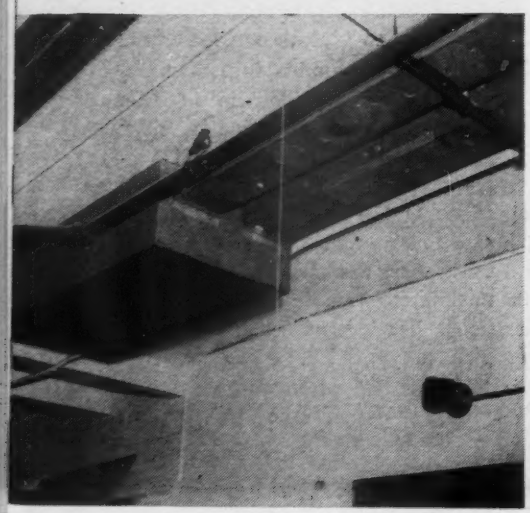


Fig. 1—Long range plans for electrical service in large plant of Garlock Packing Company, Palmyra, N. Y. include high voltage distribution to load centers.



AT war's end, reconversion seemed simple at the Garlock Packing Company plant in Palmyra, New York. Yet much had to be done. Round the clock operations had put a heavy strain on machinery, showed up weaknesses in power facilities, and pointed up the need for even greater research facilities—always a first in their long and continued growth. So plans were made; some to be carried out as promptly as material shortages would permit, others to be put into effect on a long range basis.

The first step in reconversion embraced a new Engineering Research Laboratory (Bldg. 19, Fig. 1). This building has been completed. It houses a chemical laboratory complete with analytical and microscopic facilities, a physical laboratory, an extensive test department, a rubber-compounding laboratory, and a fully equipped pilot plant. All pictures used here were made in this new building.

While making plans for power requirements for this new building, Garlock engineers in cooperation with their electrical contractor, made a survey of complete power requirements for present and proposed plant facilities. The result was a long range program in which new "load centers", to be serviced at 2300 volts, will be located at various load center areas throughout the many buildings which comprise this plant (Fig. 1).

Power is now supplied to the plant through two transformer sub-stations (A and B), and by a turbo-generator in Building 1. New plans call for elimination of substation B, increase of capacity of substation A, and provision at each "load center" to use either *purchased* power or *generated* power (Fig. 2). Purchased power is now supplied at 33,000 volts primary.

Fig. 2—Load center in engineering research building (19). Capacity is 750 kva., 2300 volts primary, 460 volts, 3 phase secondary. Space has been provided alongside solenoid operated power panel and overcurrent relay cabinet (left) to install a plant "generated" power panel.

Fig. 3—Two Flexipower 460 volt, 600 amp. bus ducts extend from pull box located on basement ceiling under load center, to supply all power to engineering research building.

Long Range Plans

Reconversion plans of Garlock Packing Company include program for expansion of electrical facilities and greater use of electric power in their plant at Palmyra, New York.

By Berlon C. Cooper

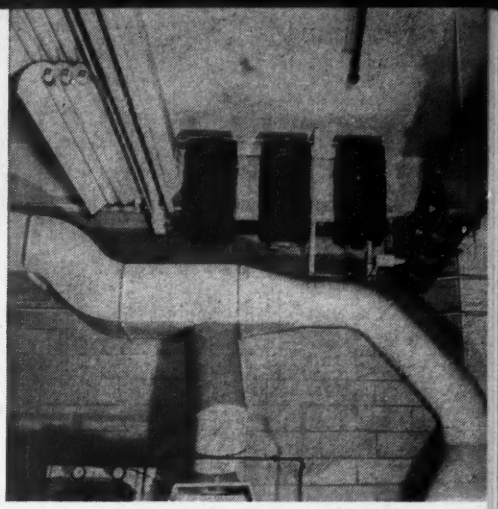


Fig. 4—Bank of three 10-kva. dry type transformers provide power for lighting at 120-208 volts on each floor.

Present capacity of substation A is three 333 kva. transformers. Three 500 kva. transformers have been ordered and will be added soon, boosting the total capacity to 2500 kva.

A new building (Bldg. 20) is now under construction. A 750 kva. load center identical to the one in the engineering research laboratory (Fig. 2) is on order. It will be installed early in 1947. Other load centers, now supplied through substation B and from the turbo-generator set, will be modernized and changed over gradually to fit into the long range planning.

Distribution of power from load centers is by means of 460 volt, 600 amp., 3-phase, 3-wire bus duct (Fig. 3). Power for lighting loads is obtained from the bus duct, using three 10 kva. dry type transformers (Fig. 4), located at the center of lighting loads. Similar banks of dry type transformers furnish power for various industrial heat loads. No. 12 wire is used throughout for lighting circuits. Secondary voltage for lighting is 3-phase, 4-wire, 120-208 volts.

Lighting intensities in the new engineering research laboratory average 50 footcandles, obtained from Miller Company industrial fluorescent reflectors. URC type fluorescent units are used in office areas. Similar lighting will be installed in other parts of the plant.

Garlock engineers chiefly responsible for these long range plans were Martin Fiero, plant engineer, and Freeman Spanganberg, chief electrician. Their electrical contractor, who cooperated throughout in working out all details, was Ray Hornbeck, president, T. H. Green Electric Company, Rochester, N. Y.

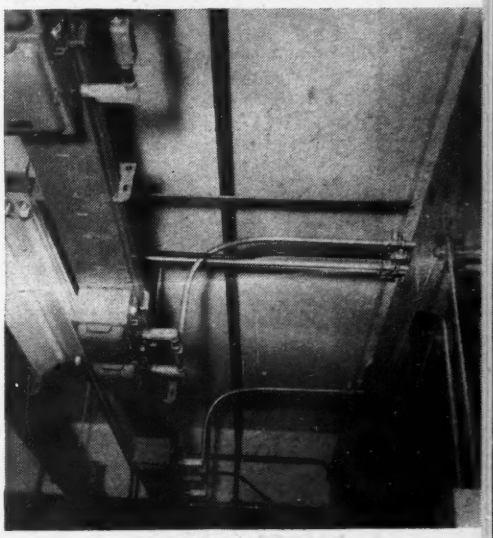


Fig. 5—Explosion-proof wiring to a hazardous location is by means of conduit tapped into bus duct outside the room. Note sealing fittings in conduit on wall near ceiling.

Fig. 6—Special plugs and four No. 12 wires in rubber-covered cable supply 3-phase, 460 volt power to motors in test room. Fourth wire is ground wire. Conduits from bus duct are on column at center of line of motors.

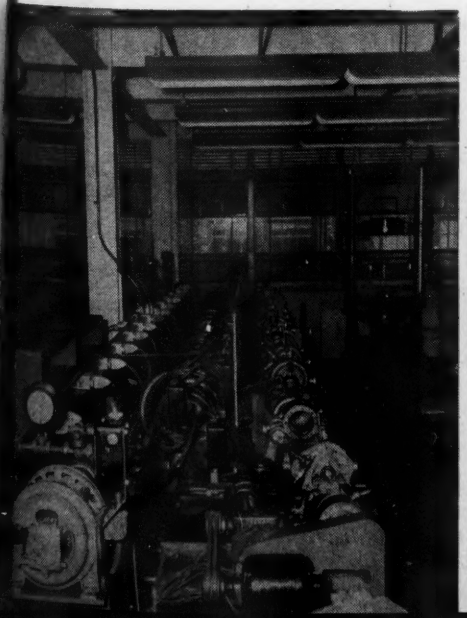


Fig. 7—A-c power from bus duct feeds through conduit (1) to 150 hp., 1200 rpm., 440 volt synchronous motor, direct connected to a 100 kw., 250 volt d-c generator. Bus duct (2) supplies this d-c service to motors nearby.

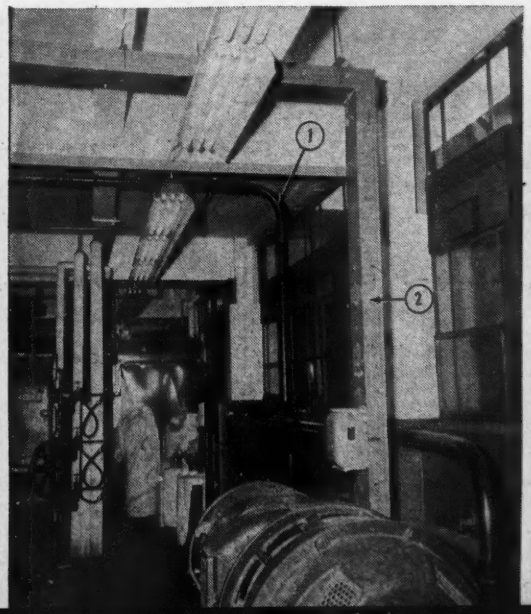
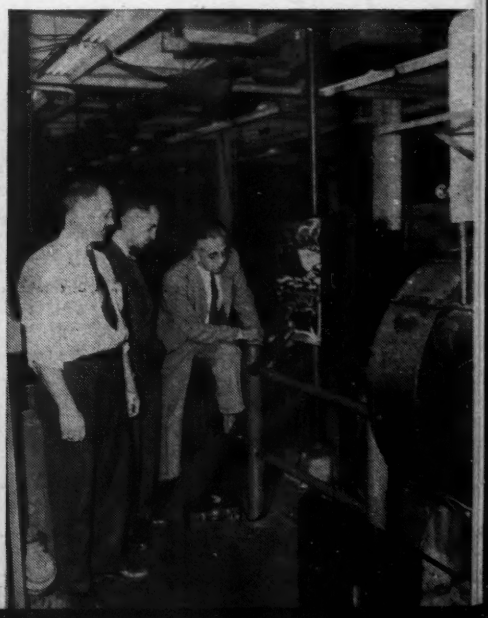


Fig. 8—Garlock's chief electrician, Freeman Spanganberg, and plant engineer, Martin Fiero, (l. to r.) watch meter as electrical contractor Ray Hornbeck, T. H. Green Electric Company, supervises a motor test.



STANDARD SYMBOLS

Preferred symbols for wiring plans and electrical apparatus diagrams.

Graphical symbols provide the specialized information necessary to understanding plans and diagrams. While any arbitrary set of symbols with an appropriate key can be used, standard symbols, accepted and widely used in the industry are more easily recognized and understood. They convey information, therefore, more quickly, accurately and efficiently. The accompanying symbols are preferred types based upon the recommendations of the American Standards Association. Official standards of ASA are "Graphical Electrical Symbols for Architectural Plans ASA Z32.9-1943" and "Graphical Symbols for Power, Control and Measurement Z32.9-1946".

GRAPHICAL SYMBOLS FOR ONE LINE SWITCHGEAR AND APPARATUS DIAGRAMS

GRAPHICAL ELECTRICAL SYMBOLS FOR ARCHITECTURAL PLANS

Ceiling Wall.

GENERAL OUTLETS

- Outlet.
- Blanked Outlet.
- Drop Cord.
- Electrical Outlet; for use only when circle used alone might be confused with columns, plumbing symbols, etc.
- Fan Outlet.
- Junction Box.
- Lamp Holder.
- Lamp Holder with Pull Switch.
- Pull Switch.
- Outlet for Vapor Discharge Lamp.
- Exit Light Outlet.
- Clock Outlet. (Specify Voltage)

CONVENIENCE OUTLETS

- Duplex Convenience Outlet.
- Convenience Outlet other than Duplex. 1=Single, 3=Triplex, etc.
- WP Weatherproof Convenience Outlet
- R Range Outlet
- S Switch and Convenience Outlet.
- R Radio and Convenience Outlet.
- Special Purpose Outlet. (Des. in Spec.)
- Floor Outlet.

SWITCH OUTLETS

- S Single Pole Switch.
- S_2 Double Pole Switch.
- S_3 Three Way Switch.
- S_4 Four Way Switch.
- S_D Automatic Door Switch.
- S_E Electrolier Switch.
- S_K Key Operated Switch.
- S_P Switch and Pilot Lamp.
- S_{CB} Circuit Breaker.
- S_{WCB} Weatherproof Circuit Breaker.
- S_{MC} Momentary Contact Switch.
- S_{RC} Remote Control Switch.
- S_{WP} Weatherproof Switch.
- S_F Fused Switch.
- S_{WF} Weatherproof Fused Switch.

SPECIAL OUTLETS

a,b,c, etc — Any Standard Symbol as given above with the addition of a lower case subscript letter may be used to designate some special variation of Standard Equipment of particular interest in a specific set of Architectural Plans.

When used they must be listed in the Key of Symbols on each drawing and if necessary further described in the specifications.

PANELS, CIRCUITS, AND MISCELLANEOUS

- Lighting Panel.
- Power Panel.
- Branch Circuit; Concealed in Ceiling or Wall.
- Branch Circuit; Concealed in Floor.
- Branch Circuit; Exposed.
- Home Run to Panel Board. Indicate number of Circuits by number of arrows.
  Note: Any circuit without further designation indicates a two-wire circuit. For a greater number of wires indicate as follows: (3 wires) (4 wires), etc.
- Feeders. Note: Use heavy lines and designate by number corresponding to listing in Feeder Schedule.
- Underfloor Duct and Junction Box. Triple System.
  Note: For double or single systems eliminate one or two lines. This symbol is equally adaptable to auxiliary system layouts.
- G Generator.
- M Motor.
- I Instrument.
- T Power Transformer. (Or draw to scale.)
- Controller.
- Isolating Switch.

AUXILIARY SYSTEMS

- Push Button.
- Buzzer.
- Bell.
- Annunciator.
- Outside Telephone.
- Interconnecting Telephone.
- Telephone Switchboard.
- T Bell Ringing Transformer.
- D Electric Door Opener.
- F Fire Alarm Bell.
- F Fire Alarm Station.
- City Fire Alarm Station.
- FA Fire Alarm Central Station.
- FS Automatic Fire Alarm Device.
- W Watchman's Station.
- W Watchman's Central Station.
- H Horn.
- N Nurse's Signal Plug.
- M Maid's Signal Plug.
- R Radio Outlet.
- SC Signal Central Station.
- Interconnection Box.
- Battery.
- Auxiliary System Circuits.
  Note: Any line without further designation indicates a 2-Wire System. For a greater number of wires designate with numerals in manner similar to———12-No. 18W-¾" C., or designate by number corresponding to listing in Schedule.
- a,b,c Special Auxiliary Outlets.
  Subscript letters refer to notes on plans or detailed description in specifications.

Treated Brushes

Chemically treated carbon brushes frequently improve motor commutation. General industrial application awaits additional developments.

By J. V. Dobson,
Chief Engineer, Stackpole Carbon Co., St. Mary's, Pennsylvania

CURRENT collection from commutators and sliprings is best when a copper oxide film surface is present. Breakdown of this film surface materially affects commutation efficiency because it depends largely on the number of contact points between brush and surface. The problem then, is to provide brushes that will continuously repair the copper oxide film regardless of operating conditions.

Such a chemically treated brush, developed for aircraft generators during the war, appeared to be the answer to troublesome commutating problems in industry. However, analysis revealed that operating conditions at 30,000 feet and on the earth's surface are not similar. In the sub-stratosphere the problem is lack of oxygen; on the ground it is air-contamination from smoke, chemicals, dust, dirt, oil, grease, and moisture. The effect of air contamination is illustrated by two identical 1500 kw. generators that were built and installed simultaneously not more than six feet apart in the same power house. One gave no end of commutating trouble; the other operated trouble free. The only difference in operating conditions was the manner of air flow over the commutators. When this was corrected the performance of both generators was the same; excellent.

Post War Research

As soon as research engineers were relieved of the high altitude brush problem, attention was directed toward the development of treated brushes for industrial use. Simultaneously, and in order to gain experience, a few industrial brushes were made with the same ingredients that went into the high altitude brush. These were put on many different machines and, as might be expected, the best results varied as widely as the applications. Regardless, the general conclusions were that the treated brush has merit.

Just as the relative simplicity of the high altitude situation worked in its favor, paradoxically the complexity of the industrial situation mitigates against it. In the sub-stratosphere the problem is to provide a brush that will maintain the copper oxide film in an uncontaminated rare atmosphere on a limited number of types of generators. On the ground the problem is much the same as regards the oxide film but beyond this the similarity ceases. Air contamination coupled with the multiplicity of designs and types of armatures and collector rings to be found in industry makes it impossible to use one combination of ingredients for carbon brushes that will work equally well under all conditions.

Problems of Design

Added to operational commutating problems are those of design and manufacture. The design engineer will take full advantage of every new brush development by using the increased application factor to design to closer tolerances. This is a logical move, necessitated by economics, for it is cheaper to conserve weight and first cost than to capitalize the savings that might otherwise accrue on brush and commutator maintenance cost. The production engineer also will take every advantage of each new brush development since better commutator performance may be turned into greater output.

Commutation is the least tangible element of generator and motor design or performance, and presents a real challenge to developmental effort. The multiplicity of factors affecting its design precludes its being reduced to the same definite design limits that apply to the iron or copper circuit of the machine. A firmer understanding of the underlying fundamentals of commutation brush riding, brush contact, brush friction, and brush contact drop, must be completely understood before significant advances can be expected.

Industrial Experience

Experience gained with industrial brushes compounded from high-altitude ingredients will prove invaluable to further brush development. It also definitely indicates that, regardless of opinions, the treated brush is not always the answer. A summary of field tests follows:

The widest field of successful application has been in the steel mill industry. Some railway motor applications have shown a distinct improvement; on others the gain has not been so apparent. This is true also for high speed turbine exciters.

As usual in carbon brush applications, there have been disappointments. Certain factors, that a treated brush cannot be expected to correct, influence commutation. For example: Commutation on motors or generators operating in atmospheres heavily laden with abrasive materials (grit, iron particles, asbestos particles from roofing) can scarcely be improved by use of treated brushes. The abrasive wear of the copper oxide film is faster than the repair by the chemical re-oxidizing of the commutator surface.

Treated brushes used thus far have not remedied the troubles prevalent in highly corrosive atmospheres, such as in the electro-chemical industry or in the paper mill industry.

On motors and generators where brush and commutator life is perfectly adequate it is extremely difficult to show any economy by the use of the treated brush despite the slight cost increase.

In some applications the gain has

[Continued on page 97]

THE LABOR CRISIS

..."Absolute power corrupts absolutely"

THE NEW CONGRESS is going to overhaul the federal laws governing organized labor. If the election returns left any doubt about that, John L. Lewis has removed it by torturing the nation with its second soft coal strike in six months.

If, however, the overhauling is to get at the roots of our labor troubles, it must go further and deeper than most of the proposals would go. Indeed, it must not stop until it has dealt decisively with that most basic cause of devastating trouble – the entrenched monopolistic power of enormous international unions, now concentrated in a handful of union leaders. Industry-wide collective bargaining is one outgrowth of this power.

"Power tends to corrupt, and absolute power corrupts absolutely." That great truth, phrased by the historian Acton, is as true of labor leaders as it is of business leaders, princes or potentates. It is also true that John L. Lewis and some of his fellow labor leaders now wield what approaches absolute power in their respective domains. Failure to recognize these facts and act on them can make a tragic mockery of the present opportunity to restore good sense and good order to our labor relations and our national life.

To realize this opportunity the labor monopoly must be made a major target.

In the minds of many people, particularly in the business community, the root cause of our labor troubles is to be found in the National Labor Relations Act, commonly called the Wagner Act. They feel that if they could get rid of the one-sided handling of a number of key labor problems provided by that act and its administrators, we would have the legislative part of the problem of creating good labor relations pretty well solved.

To be sure, there is occasion, long overdue, to balance up the lopsided treatment of labor relations by the Wagner Act and those who apply it. It has been so interpreted and applied as to deny free speech to employers. On occasion it has extended the special protection of the federal government to workers striking to force employers to break the law. It has done the same for workers striking to force the federal government to change its policy the way the strikers want it changed.

The Wagner Act has required employers to bargain with unions, but imposed no companion obligation upon unions to bargain with employers. It has given protection to workers who have broken their agreement by striking. It has been applied so as to break orderly lines of management by encouraging and giving special protection to union organization of foremen who, to do their work efficiently, must represent management. Abuses such as these should be cleaned up, and soon.

Monopoly is the Target

But if perfection were attained in eliminating all of the abuses stemming from the Wagner Act, numerous and grievous as they are, the basic problem of establishing the legislative foundations of sane and safe labor relations in the United States would by no means be solved. John L. Lewis and his fellow labor dictators would, no doubt, be annoyed, but their power would not be seriously impaired. *That power is derived from monopoly control of labor.* Just as in the case with any other kind of monopoly power, it will only be made subservient to the public interest by attacking it at the source and smashing it.

The way to do that is to apply the anti-monopoly laws to monopolies in the field of labor just as they are applied to business and industrial monopolies. At the same time more vitality should be pumped into these laws all along the line.

When our basic anti-monopoly law, the Sherman Antitrust Act, was passed in 1890, it was designed to apply to economic monopolies of all kinds, and was so held by the courts. Organized labor sought exemption from this law, largely on the ground that its bargaining power was weak, as compared with that of industrial corporations. In recent decisions, a majority of the United States Supreme Court

justices have held that, when combined with the Clayton Act of 1914, the Norris-La Guardia Act of 1932 gives organized labor virtually complete exemption from the antitrust laws.

In the meantime, the relative weakness in bargaining power which was made the occasion for exempting organized labor from the antitrust laws has become a myth. In soft coal, John L. Lewis is the monopolist. Through his United Mine Workers he controls about 90% of the miners. No one of the thousand or more highly competitive companies engaged in soft coal mining controls more than about 5% of the output.

In steel the monopoly control is that of Philip Murray's United Steel Workers whose organization represents well over 80% of the production workers in that industry. United States Steel, the corporate "giant," controls only about one-third of the steel making capacity. In automobiles the United Automobile Workers represent about 90% of the production workers. A year ago the union's officers flaunted their monopoly power by announcing plans to pick off one automobile manufacturer after another by a series of centrally controlled strikes.

Industry-Wide Bargaining

Confronted by the rise of government-fostered monopoly power in the hands of organized labor, employers in some industries have sought to match it by joining together for collective bargaining on a more or less industry-wide basis. In other industries, notably steel, the federal government, through the War Labor Board, took the lead in forcing a pattern of industry-wide bargaining. Bedevilled by a myriad of cases, the Board thus sought to settle scores of them in the steel industry by one action.

It is easy to understand how an employer, confronted by an industry-wide monopoly of labor, would be tempted to join with his fellow employers in an industry-wide bargaining group. In that way he might see a chance to establish something like equality in bargaining power.

However, if the employers' bargaining group were as effective as the union in creating a monopoly set-up, it would merely confront one monopoly with another. That, in turn, would heighten the chances of having either a devastating head-on collision as a result of failure to agree, or having the two monopolies reach an agreement at the expense of the consuming public.

Actually, however, the chances that employers can create an industry-wide bargaining group as tight as that created on the side of labor by union organization are virtually zero. For if a group of employers were to agree to shut down in unison or take other united steps to balance the bargaining power created by the threat of a monopolistic union to strike, they would unquestionably find themselves on the receiving end of an indictment for violation of the federal antitrust laws.

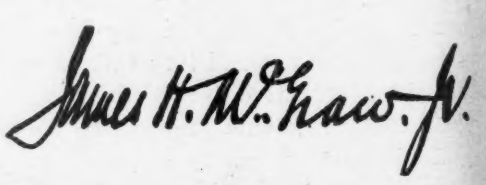
To Break the Monopoly

Thus, both from the point of view of the public and the point of view of the employer, industry-wide bargaining is no effective offset to the monopoly power created by industry-wide unions.

The only way to cope with this monopoly power is to subject it to the anti-monopoly laws in the same way business and industrial management are subjected. In the process industry-wide labor monopolies would be cut down to safe size, possibly by limiting the percentage of workers in any industry who are permitted to belong to a single labor organization.

Also application of anti-monopoly laws would clean out local pockets of labor monopoly which block the way of industrial progress. As matters stand, the freedom of unions from control by the antitrust laws permits organized workers in one city to refuse to install equipment shipped in from another city, thus establishing private tariff walls. It also permits organized workers to refuse to install or work on materials made by other workers whose union affiliation, or lack of it, they do not like.

If the anti-monopoly laws were applied to organized labor, boycotts of this sort would be outlawed. In the aggregate they now take a tremendous toll for no legitimate purpose. But primarily John L. Lewis and a handful of his fellow labor dictators might be cut down to a size that can be safely accommodated by the American democracy. If that is not done, the last great opportunity to give industrial and political democracy a chance to work, in its last great stronghold, will be lost. From such a tragic turn of events no one would lose more than the American worker.



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THIS IS THE 53RD OF A SERIES

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

Practical Methods

Handholes Reduce Patching Costs

WIRING

One item of cost that may vary considerably in rewiring work is that of channeling and patching walls and ceilings. Contractors are always seeking methods of reducing this item to an absolute minimum.

Spring Electric Company, Canton, Ohio, employs the "handhole" method wherever possible. As implied, it involves punching small handholes either in the ceiling or wall to facilitate installation of armored cable outlet extensions or switch legs.

During the recent rewiring of Canton's St. Francis Hotel, Spring electricians encountered a number of hollow brick partitions in which this method was used to advantage. Handholes were made at regular intervals (spacing depending on ease of cable installation) along the wall and the cable extension fished in the openings. Instead of plastering up a long channel, only the small holes had to be touched up (See Fig. 1).

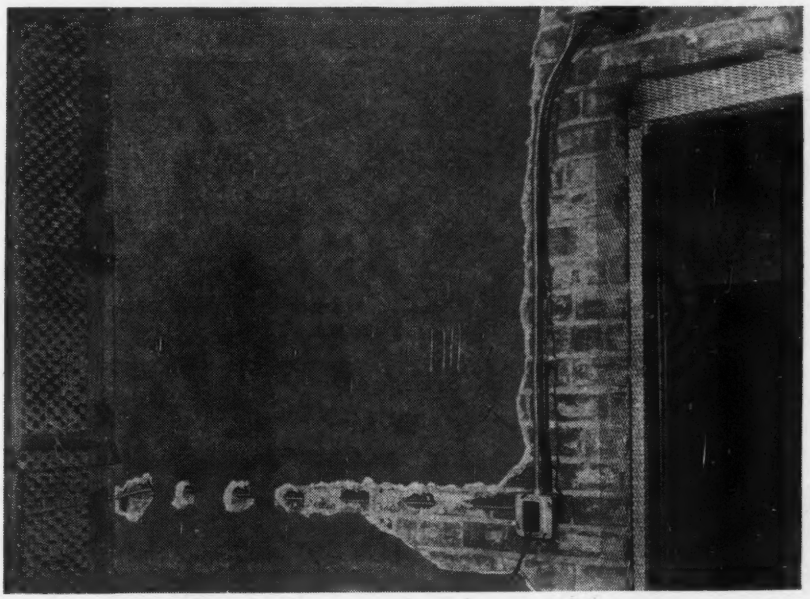

FIG. 1—Handholes, rather than long channel, are punched in hollow brick wall partition. Armored cable is then fished in wall to new switch location.

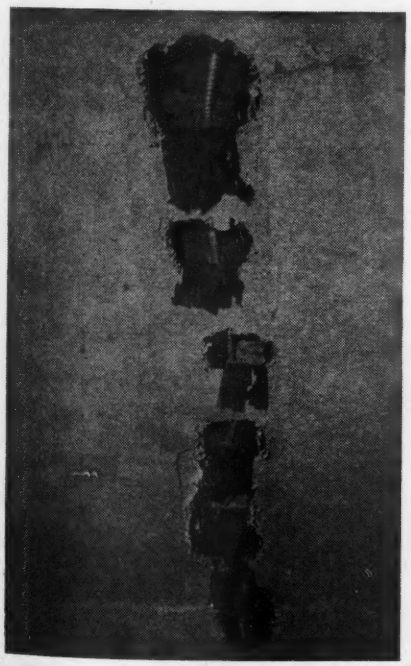

FIG. 2—Same method applied to plaster ceiling. Metal lath bent back to permit drilling of beams. Lath is later replaced and patch-plastered.

The same idea was used for switch legs installed in the plaster ceiling. Where the cable run was at right angles to the wood beams, a small area of plaster was removed between beams and the metal lath cut and bent back (Fig. 2). Electricians used these access holes to drill the beams and feed the bx cable across and down to the wall switch.

Taken on the basis of a single cable extension, the savings may appear to be inconsequential. However, from the standpoint of an overall job, such as the 200-room hotel mentioned above, the economy in labor and materials could add up to a sizable sum.

Breakers Protect College Circuits

WIRING

A method for insuring dormitory circuits against overloads and reducing the number of blown fuses is suggested by T. H. Joseph, president of the E-J Electric Installation Company, New York City, electrical contractors employed by Cornell University, Ithaca, N. Y., in connection with their present building and expansion program.

Overloaded circuits and blown fuses are common occurrences in many college dormitories due to students connecting high-wattage heating equipment to convenience receptacles designed for the normal demands of lighting units, clocks and radios. Appliances responsible for these overloads include irons, coffee percolators, toasters and grills. Since circuits normally serve several rooms, an overload caused by one offender results in the inconvenience of all those served by the same circuit.

In designing Cornell's new, modern, 426-room Women's Dormitory, architects Bagg and Newkirk acted on the suggestion of Mr. Fowler, the university's chief electrician, to protect circuits against such overloads. On all floors designated for bedrooms, conventional panelboards with 15 amp. circuits were omitted and, in their place, four No. 6 wires on 50 amp. circuits were run down the center of each corridor ceiling, delivering cur-

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Millite provides controlled illumination in high bay areas. The heat-tempered, impact-resisting, hinged glass cover permits easy access for lamp replacement.

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rent to specially designed 8 by 12 by 4 inch boxes serving the hall lighting fixtures. At each corridor ceiling box, four pair of No. 12's are tapped off to four No. 0111 combined switch and magnetic circuit breakers set at 6 amps.; each pair of wires serving a group of four bedrooms. In the event that a student connects too many appliances and overloads the circuit, the breaker opens and cuts off the one room without interrupting service to others on the same main circuit. The lights in the room containing the overload cannot be restored to service until the offending appliance has been removed.

The system is proving satisfactory and service calls to replace fuses have been eliminated. Special facilities are provided in each wing of each floor for electric ironing and laundry work.

Credited with the construction work is the building firm of Barr and Lane.

A Woodward electrician demonstrates operation of the hole boring machine. Abrasive is poured in opening at base of cylinder. Hole in foreground was just made by this unit.

Shock-Proof Hole Boring

CONSTRUCTION

Practically every contractor and maintenance electrician has encountered the task of drilling access holes through concrete floor slabs. The methods employed vary from the hand sledge and star drill or bull point to air or electric drills and other boring machines. Choice of a specific tool depends on diameter of the hole; thickness of slab; type of floor (tile, terrazo, marble, etc.); and general surrounding working conditions (location in an office, precision manufacturing or other area).

Engineers at the Woodward Governor Company, Rockford, Ill., prefer a boring machine for this type of work because of its relatively quiet and vibrationless operation. The absence of repeated shocks inherent in the operation of air or electric drills or hand tools—is an absolute assurance against cracking the slab or chipping the floor finish (if it be terrazo, tile or other polished surfaces). An added advantage is the elimination of shock transmittal to surrounding machine tools—an important feature where precision machine work is done. Its quiet operation permits its use either in office or production areas, during normal working hours, without disturbing personnel in the immediate vicinity. The absolutely smooth true hole produced by this unit facilitates accurate spotting and installation of conduits and ducts—a desirable feature when working under the handicap of close dimensions. Also, finish patching and grouting are unnecessary.

The Howe-Simpson unit illustrated in the accompanying photograph is used at the Woodward plant. Basically, it consists of a cast metal base that has a collar and vertical guides for the rotating grinding tube. A ¾ hp. motor drives the tube shaft by a V-belt connection; step-pulleys providing speed changes. The operator applies downward pressure as illustrated.

Actual cutting of the concrete is done by a carborundum abrasive which, mixed with water, is poured into an opening at the base of the unit. The entire outline of the base is caulked to the floor with putty to prevent overflow of the mixture. Cutting (or grinding) cylinders—of various diameters—are soft, seamless steel tubes (about 1/16 inch thick) cut to length for various slab thicknesses. A single notch, cut into the bottom periphery of the tube, permits constant feeding of the carborundum mixture into the groove being ground into the floor as the process continues. Technically speaking, the holes are not cut in the concrete, but are produced by a lapping or grinding action of the tube and abrasive—just as holes are made in glass with a soft lap and compound. After the hole is through, the grinding tube is retracted and the cut-off cylindrical section of concrete removed from the interior of the tube.

Time required to produce a hole with this unit compares favorably with other methods. It varies, of course, with the diameter of hole, thickness of slab, type of aggregate (small or large stones), and the number of steel reinforcing rods encountered. Woodward engineers report that, under normal conditions, a 4-inch diameter hole can be bored in a 12-inch slab in about five hours (electrical estimating manual units vary from 5.0 to 6.6 hours). The time may go as low as four hours if the slab contains unusually small gravel, or as high as seven or eight hours if steel reinforcing rods are encountered. This time factor is the only effect that steel rods have on this operation. The grinding cylinder makes the same smooth and true cut through them as it does through the concrete.

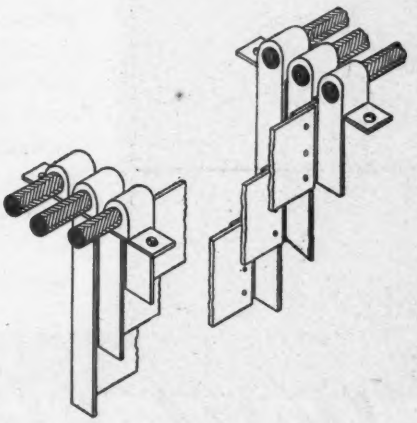
It was not the time element, but the physical advantages previously mentioned that led Woodward engineers to choose this specific method of cutting holes in the concrete floors of their plant.

Cable Busbar Distribution

INDUSTRIAL

Faced with a scarcity of rolled copper bars, yet desirous of securing the advantages of a bus duct distribution system, the electrical engineering department of Bethlehem Steel's Staten Island, New York, shipyard installed a combination cable bus system which by-passed the bottleneck of critical materials.

Current is now carried throughout the shops by 500 MCM cables in 4-inch conduit located 12 feet above the floor level. At intervals of 20 feet along each feeder, specially constructed junction



Special junction boxes connect feeder cables to copper busbars and create flexibility of busduct distribution.

This is our neck sticking out

BUT . . .

we have been making reasonably prompt delivery on these two HAZARD Products. We expect to continue, because less critical materials are required for their manufacture.

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Tough . . . flexible . . . long lived because from the smallest size to the largest, they are all pressured-cured in continuous metal molds — a Hazard process that provides maximum jacket density . . . extra surface smoothness . . . more all around resistance to mechanical damage. All Hazacords are now made with a Hazaprene Jacket for protection against oil, grease, sunlight, water, chemicals, etc. . . . ample flexibility is provided by numerous copper wires skillfully stranded to form the conductors.

HAZARD ARMORTITE

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For power and lighting, building entrances, airport lighting, power runs between buildings — Armortite gives you the advantages of an underground installation yet saves time and money because it requires no conduit. All the necessary protection for direct burial is built into Armortite itself. Its submarine-type insulation successfully withstands water, acids and alkalies. The tough outer sheath of plastic sealing compound, asphalted jute coverings and non-metallic armor tape provides full protection against mechanical damage. As it has no lead sheath or steel armor, Armortite is light in weight, quick and easy to install. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pennsylvania.

HAZARD **insulated wires and cables for every electrical use**

boxes are installed for the purpose of connecting branch feeders from the high current-carrying mains to local areas and the many machines in operation.

Each connection box contains three horizontal 18-inch copper bars of ¼ by 1½-inch stock, riveted at either end to vertical junction bars. Cable clamps at the top of the junction bars are supported by insulated mounting strips. The short busbar sections are stepped in different horizontal and vertical planes so that connections of branch circuits can be installed quickly and efficiently. Each assembly of bars and junction cable-clamps is mounted in a safety-covered steel outlet box. The cable busbar combination greatly inproves plant flexibility by allowing rapid rearrangement of equipment and achieves the advantages of a bus duct system although bar stock was critically curtailed.

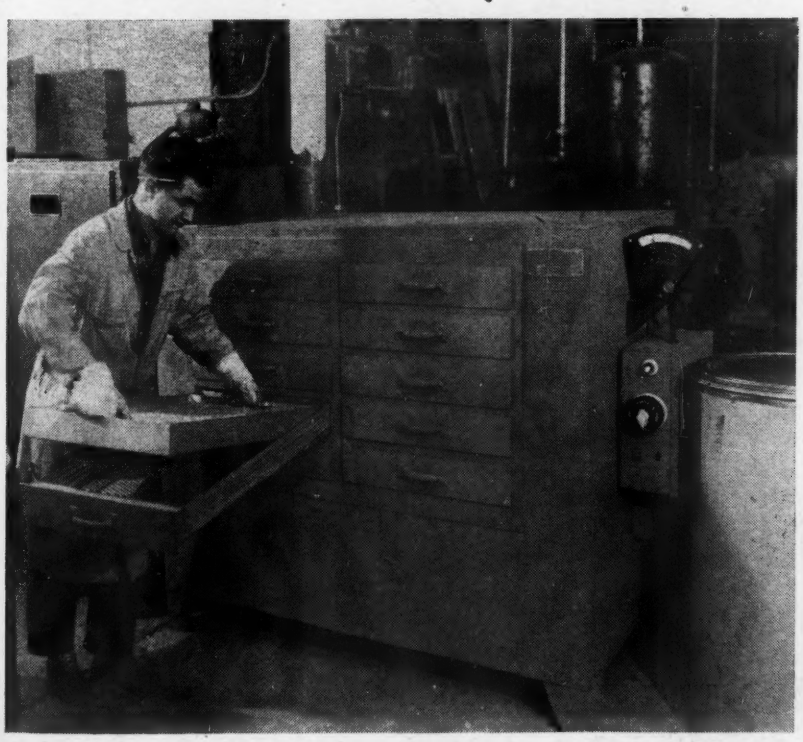
Preheating Rids Plastic Moisture

INDUSTRIAL

Preheating thermoplastic materials is solving a failure problem in the injection molding department of the Superior Plastic Company.

Repeated failures and irregularities of extruded stock were traced to the improper heating of granules. Moisture extraction was incomplete and the slight percentage of moisture remaining in the materials was adversely affecting the finished products. To eliminate these difficulties, engineers of the Despatch Oven Company, Minneapolis, Minn., recommended the use of an oven designed specifically for preheating thermoplastic material and the installation of three units solved the problem.

Each oven has a capacity which may be varied between 100 and 700 pounds of material for an eight hour day. The oven is automatically controlled to provide balanced temperatures and uniform heat flow around the ten 20 by 30 by 3½ inch drawers of metal mesh. Forced draft horizontal air flow is maintained by a special high velocity fan and heat losses through the walls of the oven are maintained at a minimum by an insulation 3-inches in thickness.



Trays of thermoplastic material are placed in the ten drawers of the preheating oven and subjected to even, high intensity heat under forced circulation to free the materials from all moisture prior to feeding into the hoppers of the extrusion presses.

What An Electrician Should Carry

TOOLS

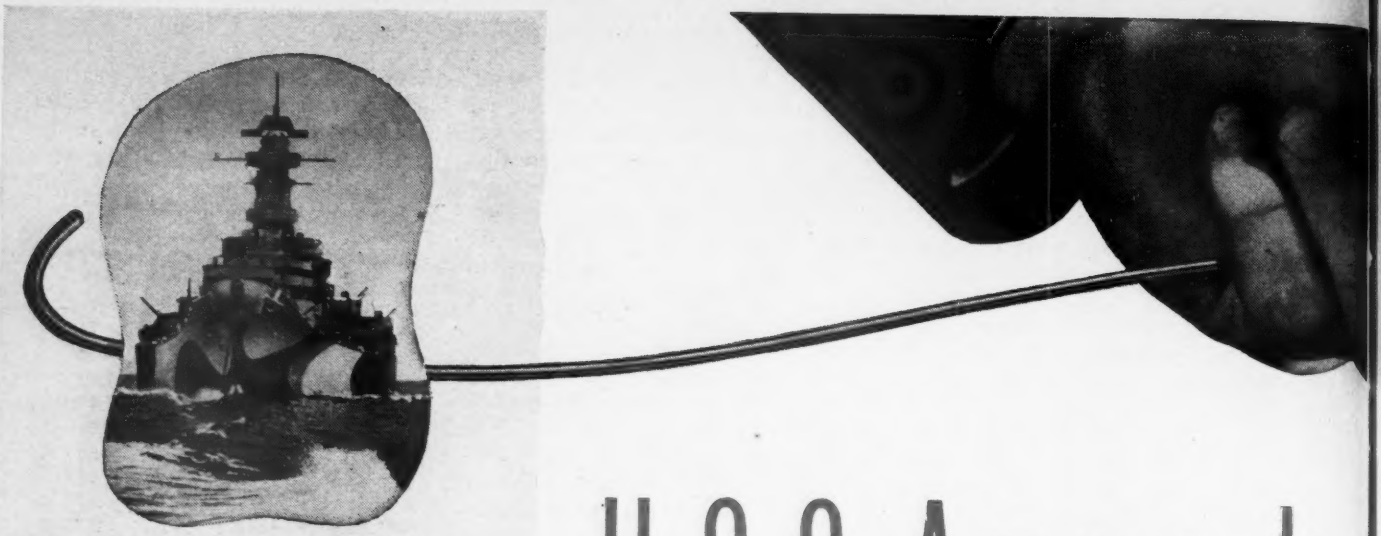
At times electricians find themselves handicapped in the field by lacking a specific tool. Lost time results from going the rounds borrowing from other men on the job. The following list, issued by the Minnesota Electrical Council, Inc., for benefit of veterans and apprentices entering the electrical construction field should be of interest to all who contemplate entering wireman apprenticeships, and for many journeymen now on the job.

Suggested Tool List for Journeymen and Apprentice Electricians

Item	Approx. Cost
Blow Torch #158A—1 Qt.	$3.75
Tool Kit	5.00
KO Punch Set #735	9.00
Hack Saw—Mephisto #50	1.49
Electric Claw Hammer	2.50
6' Rules	.50
10" Crescent Wrench	1.04
8" Crescent Wrench	.83
10" Pipe Wrench	.67
#731 Millers Falls Brace	4.25
1¼" Pipe Reamer	1.40
Screw Driver 4"	.32
Screw Driver 6"	.40
Screw Driver 8"	.53
Wood Chisel ¾"	1.00
Wood Chisel 1"	1.50
1 lb. Ball Pein Hammer	.74
8" Klein Lineman Pliers	2.33
6" Klein Oblique Pliers	1.60
6" Klein Long Nose	1.83
8" Glass Pliers	.33
50' Steel Tape	4.27
Combination Square	7.23
9" Level	2.81
Plumb Bob	3.12
Chalk Line	.25
Wood Bits ½"	.38
Wood Bits ¾"	.53
Wood Bits 1"	.68
Taps to 5/16—1 Set	5.00
Drills to 9/16—1 Set	5.00
Center Punch	.27
Key Hole Saw	1.40
Cold Chisel ½"	.46
Cold Chisel ¾"	.69
Flash Light	1.50
Fuse Pullers	1.25
Square D Voltage Tester	7.50
Solder Copper	1.00
⅛" Fish Tape	2.50
1 Set Allen Wrenches	1.00
1 Drill Carrying Case	2.90
1 Brown & Sharpe Wire Gage	3.00
1 Drill & Tap Gage	2.40
1 Screw Pitch Gage	1.50
	$98.56
1 Abbott's National Electrical Code Handbook	3.50

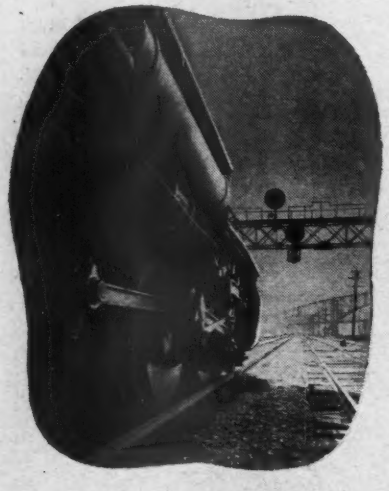
Veterans Administration will reimburse Veteran apprentices in training up to the amount of $100 for necessary tools. Receipted invoices must be furnished for such tools in order to obtain reimbursement. Veterans Administration representatives will assist Veterans or their employers in applying for reimbursement.

In any profession it is a sound policy to purchase the necessary "tools of the trade" as soon as possible. The governmental reimbursement to veterans should prove a valuable aid.



U·S·S Ampyrol

FOR FIRE CONTROL ON A BATTLESHIP...



STOPPING A TRAIN...

OR RE-WIRING A HOUSE...

Ampyrol is our trade name for several synthetic thermoplastic resin compounds of the polyvinyl chloride type and is used both as an insulating material and a protective jacket for low-voltage electric wire and cable.

Special compounding. Ampyrol is compounded to special formulas developed by the American Steel & Wire Company which improve the electrical characteristics and increase the range of operating temperatures.

High dielectric strength permits use of very thin walls which allows more power capacity in conduits of a given size.

Chemical inertness. Unaffected by moisture, acids, alkalis, oils, grease and many common solvents.

Excellent aging qualities. Does not crack.

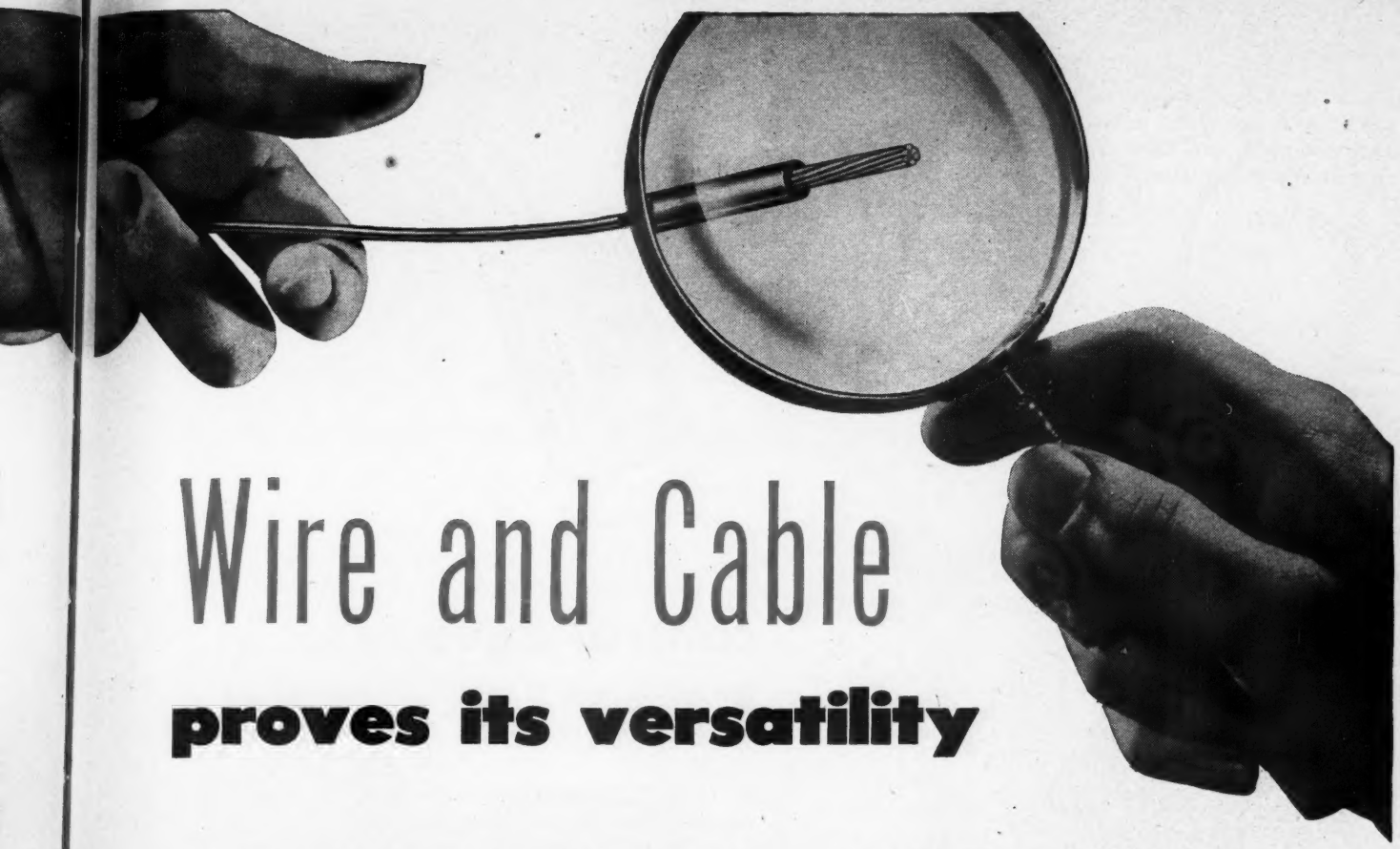
Flame-resistant. Does not support combustion or carry flame.

Unaffected by ozone, oxygen, sunlight.

Flexible, free-stripping.

Smooth lustrous surface.

Available in 12 permanent colors.



Wire and Cable

proves its versatility

FIRE CONTROL wiring on a battleship must resist flame, heat, moisture, chemicals, mildew, oil and many other destructive forces. To overcome these difficulties, engineers at American Steel & Wire Company developed U·S·S Ampyrol Wire and Cable which proved highly successful. Millions of miles of Ampyrol Wire were used for military purposes during the war.

Today, Ampyrol Wire and Cable are being used in a myriad of applications including industrial plants of all kinds, railway signalling and general construction.

WIRE FOR CHEMICAL PLANTS for example, must withstand fumes, various acids, alkalis, heat and moisture.

WIRE AND CABLE FOR RAILWAY SIGNALLING may not encounter such severe conditions but it has to withstand acids, oil, grease, heat and severe bending. Standard U·S·S Ampyrol has proved highly satisfactory in this and many other switchboard and control applications.

AS A THIN-WALLED BUILDING WIRE U·S·S Ampyrol will often allow enough extra wires in conduits to double their power carrying capacity. And, by eliminating the necessity for tearing up walls and floors, rewiring costs can often be greatly reduced.

THE APPLICATIONS OF U·S·S AMPYROL Wire and Cable are almost unlimited. For buildings, industrial plants, switchboards, control apparatus, motor leads, railway signalling, street lighting, radio sets, electronic devices and shipboard uses, it is distinctly superior. Write for complete information on types and sizes available.

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Tennessee Coal, Iron & Railroad Company, Birmingham, *Southern Distributors*

United States Steel Export Company, New York

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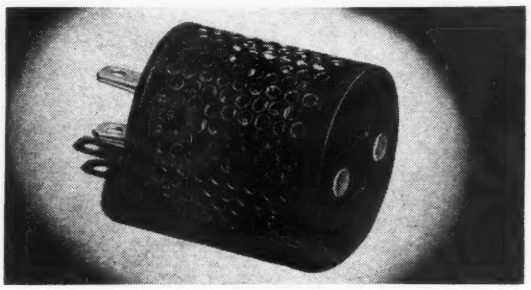
FEDERAL ELECTRIC PRODUCTS COMPANY, MANUFACTURERS OF A COMPLETE LINE OF ELECTRICAL PRODUCTS INCLUDING: MOTOR CONTROLS, SAFETY SWITCHES, CIRCUIT BREAKERS, SERVICE EQUIPMENT, PANELBOARDS AND SWITCHBOARDS

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising department, tell them in what issue of ELECTRICAL CONTRACTING you saw the item and they will send full details to you.

Equipment News

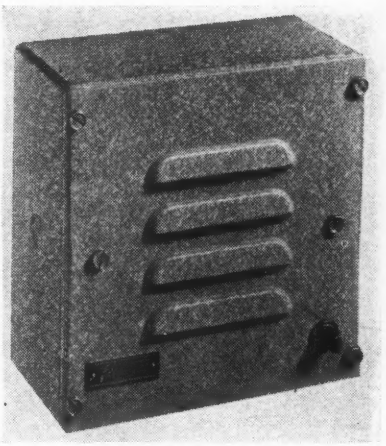
Fluorescent Resistor

A plug-in type resistor has been designed for operation of single lamp portable fluorescent fixtures on direct current. The wire wound fixed resistor is mounted in a small perforated metal enclosure, measuring 1⅝ inches in diameter and 1⅛ inches in height. Spring pressure prongs are on one end and the receptacle on the other. In use, the adapter is plugged between the lamp and d-c outlet. No wiring is required for the resistor which is connected in series with the auxiliary d-c ballast. Resistors are designed for single lamps up to and including a 20 watt T-12 24-inch size. Ward Leonard Electric Co., Mt. Vernon, N. Y.



WARD LEONARD RESISTOR

Heavy Duty Intercom Unit



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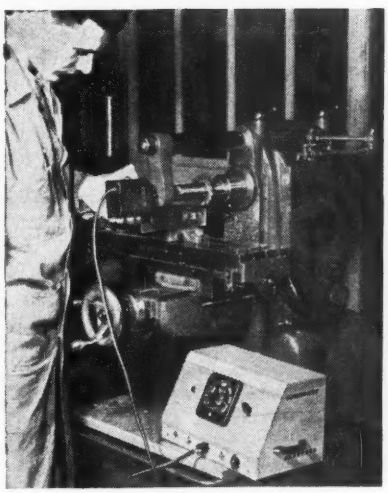
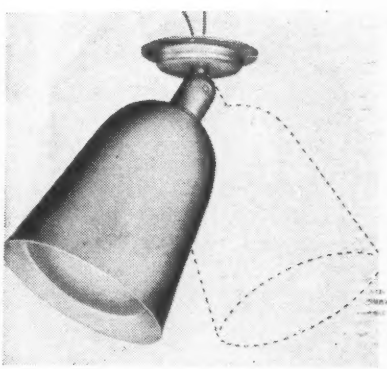
Electronic Tachometer



G. E. TACHOMETER

New electronic tachometer for measuring rotational speeds from 300 to 50,000 rpm. weighs 19 pounds and is recommended for production testing of equipment instantaneously without the necessity for any permanent attachments. The tachometer consists of a small pick-up head, six feet of flexible cable, and panel-mounted instrument recorder reading directly in rpms. Low or high speed head may be used. Pick-up head consists of light-interrupting disc and phototube. Light shines upon phototube through rotating openings, produces input signals which are transferred to measuring unit. Apparatus Department, General Electric Co., Schenectady, N. Y.

Adjustable Sockets



SWIVELIER HOODS

A series of adjustable spot lighting fixtures is obtainable in clusters of two, three and four shades attached to a single 4-inch outlet cover. The hooded shade is available for either flush mounting on a 3¼ by 4-inch outlet box cover or suspension mounting on hangers ranging from a few inches in length to three feet. The socket is held in place by means of an inside spring construction, eliminating wing nuts and adjustable set screws. All positions of mounting are possible through a 90 degree vertical arc and a horizontal sweep of 350 degrees. Swivelier Company, 30 Irving Place, New York 3, N. Y.

control devices with a FAMILY TREE

All Federal products bear this emblem but that's only the beginning of their family resemblance! You'd have to go back to Federal's engineering department, its laboratories, its far-flung manufacturing divisions—if you'd really want to see how this tree took root. For, though they may differ widely in design and application, all Federal controls have in common the characteristics of built-in quality . . . quality that guarantees performance! . . . Federal Electric Products Company.
Executive Offices: 50 Paris St., Newark 5, N. J. Plants: Hartford, Conn., Newark, N. J., St. Louis, Mo., Long Island City, N. Y.

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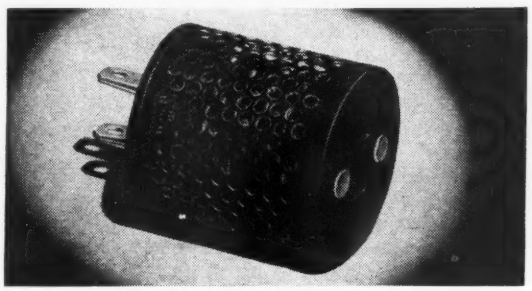
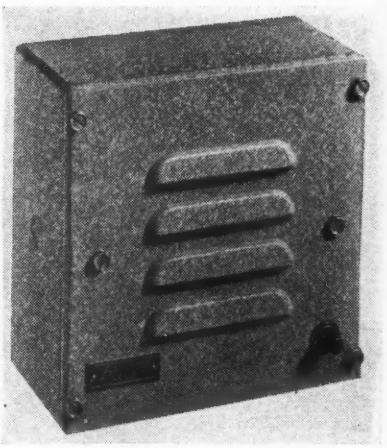


WARD LEONARD RESISTOR

Heavy Duty Intercom Unit

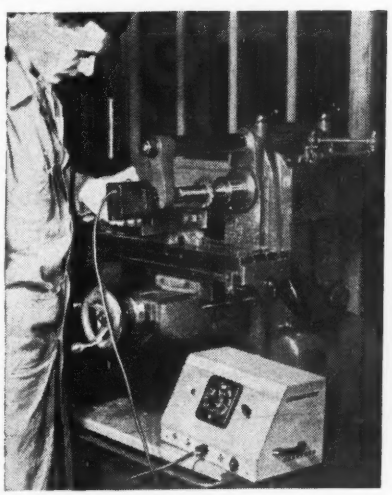


EXECUTONE STATION

Dust and moisture proof, metal housed, industrial type intercom staff stations for remote and privacy operations, are constructed for rugged wear and versatility of application. Equipped with a call-origination button, the remote type Model C-22 unit permits the user to receive a call and reply from a distance of 20 feet without approaching the station. The privacy type C-26 has a toggle switch for call origination, assuring freedom from eavesdropping when in idle position. Concealed terminals built inside the cabinet permit wiring connections, eliminate the possibility of short circuiting and protect the terminals from wear. The units are 6 by 6 by 3 inches and can be wired directly to any standard Executive Central Control Master station. Executone, Inc., 415 Lexington Ave., New York, N. Y.

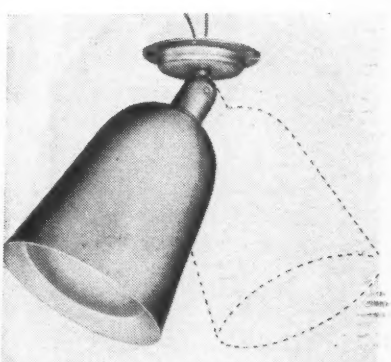
Electronic Tachometer

New electronic tachometer for measuring rotational speeds from 300 to 50,000 rpm. weighs 19 pounds and is recommended for production testing of equipment instantaneously without the necessity for any permanent attachments. The tachometer consists of a small pick-up head, six feet of flexible cable, and panel-mounted instrument recorder reading directly in rpms. Low or high speed head may be used. Pick-up head consists of light-interrupting disc and phototube. Light shines upon phototube through rotating openings, produces input signals which are transferred to measuring unit. Apparatus Department, General Electric Co., Schenectady, N. Y.



G. E. TACHOMETER

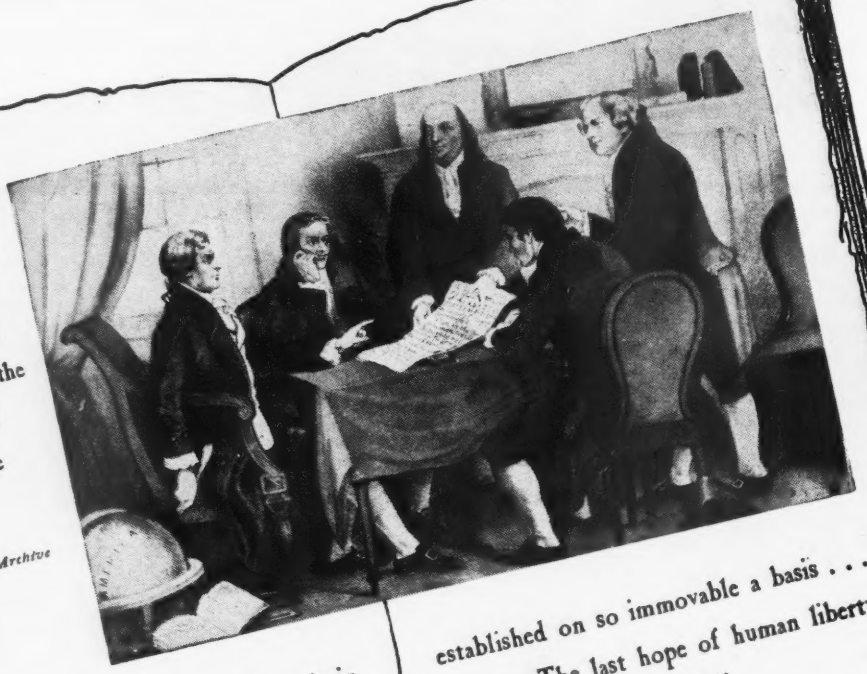
Adjustable Sockets



SWIVELIER HOODS

A series of adjustable spot lighting fixtures is obtainable in clusters of two, three and four shades attached to a single 4-inch outlet cover. The hooded shade is available for either flush mounting on a 3¼ by 4-inch outlet box cover or suspension mounting on hangers ranging from a few inches in length to three feet. The socket is held in place by means of an inside spring construction, eliminating wing nuts and adjustable set screws. All positions of mounting are possible through a 90 degree vertical arc and a horizontal sweep of 350 degrees. Swivelier Company, 30 Irving Place, New York 3, N. Y.

FAITH



Thomas Jefferson as chairman of the committee drafting the Declaration of Independence

—*The Bettmann Archive*

". . . The cement of this Union is in the heart-blood of every American. I do not believe there is on earth a government established on so immovable a basis . . . ". . . The last hope of human liberty in this world rests on us."

2nd in a series on Thomas Jefferson, Third President of the United States

Thomas Jefferson's entire life was devoted to the fight for political liberty knowing in his faith that only in a FREE land can man rise to his maximum stature.

With rightful pride in this wonderful America, the "home of the brave and the free", the Jefferson Electric Company reaffirms its faith in the unlimited potentialities of the United States where there exists, as a beacon to the entire world, "liberty and justice for all."

***TRANSFORMERS:** Power Circuit, Mercury Lamp, Oil Burner Ignition, Control, Bell Ringing, and Luminous Tube.*
***FUSES:** Jefferson-Union Renewable Fuses, Super-Lag, and Non-Renewable. BALLASTS for Fluorescent Lamps.*

JEFFERSON ELECTRIC COMPANY

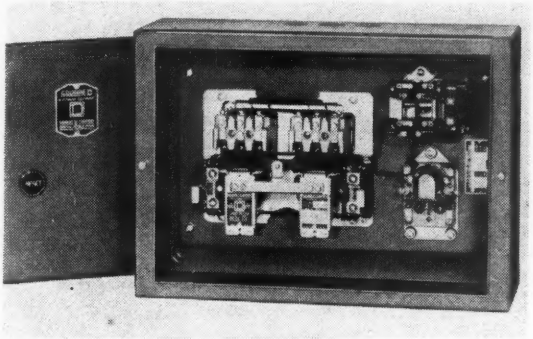
BELLWOOD, ILLINOIS *(Chicago Suburb)*

In Canada: Canadian Jefferson Electric Co., Ltd., 384 Pape Ave., Toronto, Ont.

JEFFERSON ELECTRIC

Laundry Controller

A compact, easily adjusted laundry controller has been announced. Featured are synchronous motor-driven timer for revolving and reversing washing machine or drying tumbler, overload protection in the form of high temperature melting alloy relays, sponge rubber gaskets to seal the baked enamel enclosure and control equipment, timer and brake relay. Industrial Controller division, Square D Co., 4041 N. Richards St., Milwaukee 12, Wis.



SQUARE D CONTROLLER

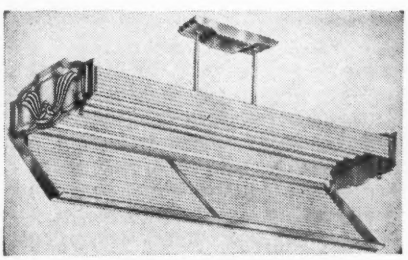
Combination Heat-Light

A combination circular fixture holds infra-red lamps and new circular fluorescent lamps. White enameled body of fixture is flared out to serve as reflector for circular light source while sockets in the face of the fixture hold either two or four sockets for heat lamps. Separate switches control each pair of heat lamps. Lamps can be operated in series or parallel, producing either 250 or 500 watts of heat. Unit can be obtained as either a flexible-shafted floor type or as a rigid stem suspended fixture. Recommended for locations where low level illumination on the surface to be heated is desired. Miskella Infra-Red Co., East 73rd and Grand Ave., Cleveland 4, Ohio.

MISKELLA HEATOLIER

Fluorescent Fixture

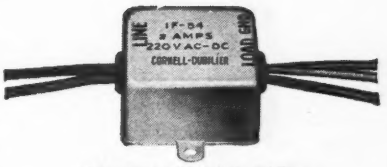
One of a series of fluorescent lighting units is the Manchester, wired with high power-factor ballast and starters for 110-125v, 60 cycle, a-c operation. It accommodates four 40 watt fluorescent lamps. Units may be flush mounted, used in continuous runs or suspension mounted. Hinged frame permits bottom of opal glass to be swung down for cleaning or maintenance purposes. Mobilite Inc., Jersey City, N. J.



MOBILITE FIXTURE

Interference Filter

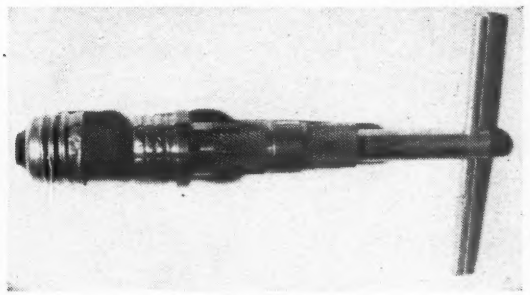
Quietone filter eliminates radio noise energy created by the operation of fluorescent lamps and many types of electrically operated machines and appliances. High attenuation of radio interference over wide frequency range is claimed for this unit which can be installed in a variety of positions. The hermetically sealed IF-54 interference filter is rated at 2 amps., 120-200 volts a-c. It is wax filled and impregnated. Cornell-Dubilier Electric Corp., South Plainfield, N. J.



CORNELL-DUBILIER FILTER

Lamp Base Extractor

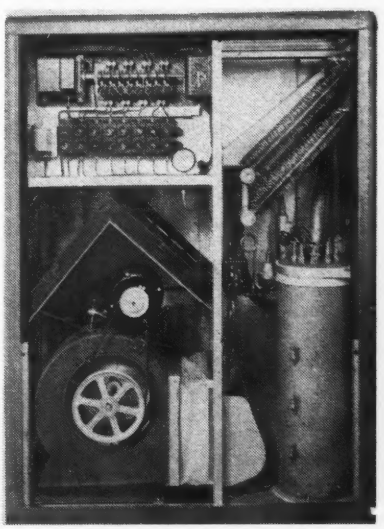
Frozen lamp bases from broken bulbs can be removed from sockets by means of a fluted, steel, threaded head which screws into the frozen base and expands to exert pressure on the inside surface of the base. Turning the rubber-handled tool removes the base from the socket. It is also used as a reamer to clean dirty, medium base, intermediate and Mogul sockets. Jack Shapiro and Son, 1240 Sherman Ave., Bronx 56, N. Y.



SHAPIRO EXTRACTOR

Vapor Central Heating

Steam vapor heating units are constructed with an intake for cool air, filter for purification, mercury switches to control electric flow to individual coils and produce constant levels of temperature, thermostat for regulating heat, circulating fan, steam generator which discharges through copper coil fins, and outlet grill for emitting steam heated air to room. Units range from 9 to 24 kw. capacity. The furnaces are sized to heat homes or buildings from 6500 to 18,000 cubic feet in volume. The Cronholm Mfg. Co., 3500 S. E. Hawthorne Ave., Portland 15, Ore.



CRONHOLM VAP-O-LEG

FOR HARD-TO-GET NUMBERS

See Your Virden Distributor

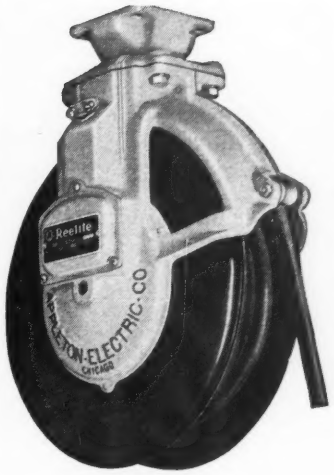
On residential lighting, it pays to ask Virden! For you know you can depend on Virden quality, lighting and value. And you can also be sure of units that are charmingly styled, pleasingly decorative . . . to fit any home need. Shown are a few items that indicate the range of Virden's line. You'll find many more at your Virden distributor—and you'll find him ready to serve you.

John C. Virden Company • Cleveland, Ohio

Member American Home Lighting Institute

Hoist Reels

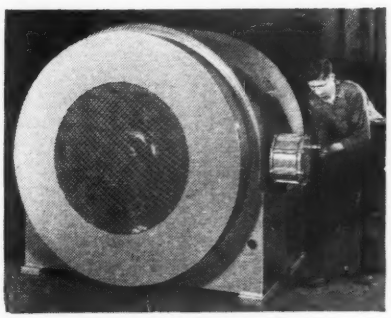
Type YS Reelite is designed for use with traveling hoists. The reel automatically takes up and pays out conductor cable. There are no exposed current collectors, trolleys or wires. Serves straight track or tracks with bends up to double the cable length. Swivel base permits rotation up to 335 degrees. Conductor cord is kept taut at all times while safety grounding affords maximum protection. Bearings are oil-less. Appleton Electric Co., 1701-59 Wellington Ave., Chicago 13, Ill.



APPLETON REELITE

Weatherproof Motors

A complete line of outdoor weatherproof totally enclosed motors in the larger sizes up to and above 2000 hp. are available. Complete redesign of the ventilation heat transfer system permits easy cleaning, self drainage and the elimination of water-trapping pockets. Allis - Chalmers Mfg. Co., Milwaukee, Wis.


ALLIS-CHALMERS MOTOR

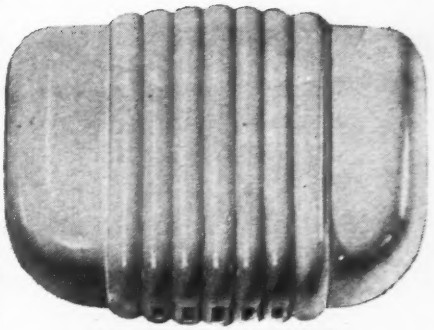
Electronic Timers

Photoswitch electric timer measures intervals from 1/20th sec. to 4 minutes. Used for control of spot welders, grinders, honing machines, drilling machines, conveyors, automatic filling machines and photographic printers. Four types of timing are provided: interval, delayed action, automatic repeat and programming. Combinations make the unit a universal timer. The electrical circuit is flexible and has a 2 percent accuracy variation. Either 115 or 230 volt supply line may be used. Only one tube and one relay are included in the unit. Photoswitch Incorporated, 77 Broadway, Cambridge 42, Mass.

PHOTOSWITCH TIMER

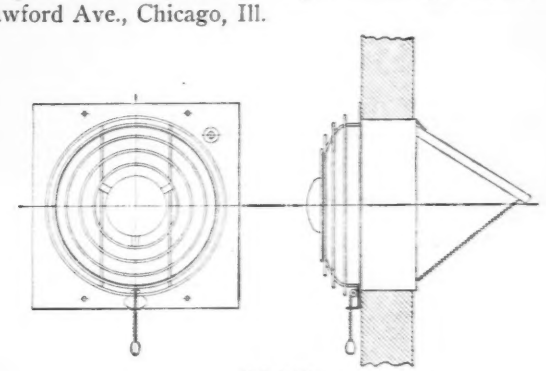
Door Chimes

New Melodeon door chime for residences is compact, self contained, fluted case unit with two musical notes; two notes sounding together for front door and one note sounding for rear entrance. The standard ivory baked enamel finish can be refinished to match any interior. The chime operates on existing wiring or on 8 to 10 volt transformer. The size is $7\frac{1}{8}$ by $5\frac{1}{4}$ by $2\frac{3}{4}$ inches. Mell-O-Chime and Signal Corp., 119 S. Jefferson St., Chicago 6, Ill.


MELL-O-CHIME MELODEON

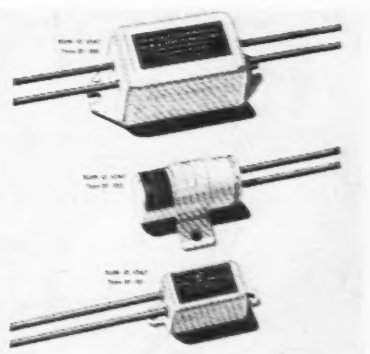
Ventilating Fan

The "Ilgvent 8-inch Package Type" electric ventilator is designed to give homes of thin-wall construction the advantages of electric ventilation. It is available with a $3\frac{1}{8}$ inch sleeve for mounting in thin walls and is also suitable for installation in a steel sash. The unit is mounted in a steel panel with a pull chain opening and closing the weather-tight outer door and simultaneously starting or stopping the fan. Capacity is 350 c.f.m., providing a two-minute air change in 700 c.f. kitchens. Ilg Ventilating Co., 2802 N. Crawford Ave., Chicago, Ill.


ILG FAN

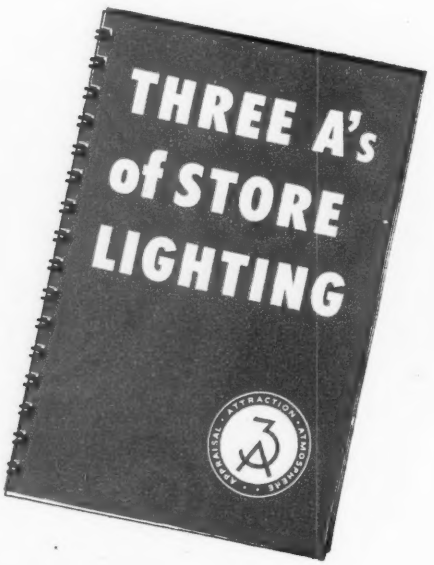
Fluorescent Sound Filters

Elimination of radio and television interference from fluorescent lamps is possible with three new filters. The filters are of two basic types, a balanced twin-pi filter for maximum attenuation and a delta capacitor filter for normal usage. They are effective over the complete radio spectrum from 150 kilocycles to 150 megacycles, taking in everything from ship-to-shore broadcasting to standard AM and FM broadcasting, international shortwave and VHF television and facsimile channels. Solor Mfg. Corp., 285 Madison Ave., New York 17, N. Y.


SOLAR FILTERS

How to make money out of other people's lighting problems

1 Is your hottest prospect walking the floor, trying to figure out the best way to modernize his store lighting? What a perfect opening for you! It's a good bet you'll get his business if you can offer him well-planned, up-to-the-minute answers to his special problems.



2 The answers you need are all in G-E's new pocket-size handbook, "Three A's of Store Lighting," a handy quick-reference manual that's chuck full of facts on sales lighting layouts, equipment and installations. It tells how planned store lighting sells merchandise, illustrates successful examples, demonstrates brand-new design ideas, and presents a wealth of data on lamps and lighting equipment.

3 Give your salesmen a break! Make "Three A's" a well-thumbed part of their selling kit. You'll find it an active help in developing profitable lighting business. "Three A's" is a steal at 50¢ a copy! To get yours, call or write your nearest G-E Lamp Office today.

Portable Rectifier

GREEN RECTIFIER

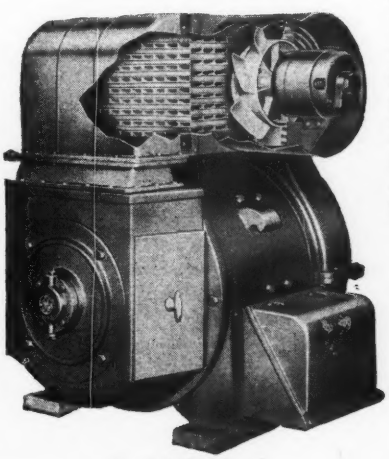
A complete d-c power supply source with a capacity of 150 watts incorporates light weight and portability. Rectifier measures 14 by 14 by 9 inches, has a continuous capacity of 25 amps. and an adjustable output from zero to 6 volts. The unit is convection cooled, has no moving parts and a single phase full wave circuit. Equipment includes ON-OFF switch, panel mounted fuse in the d-c circuit, pilot lamp, voltage control transformer, voltmeter and color coded outlet terminals. W. Green Elec. Co., Inc., 130 Cedar St., N. Y. C.

Multi-Breaker

TRUMBULL MULTI-BREAKER

Compact, streamlined multi-breaker, designed for protection of four single phase circuits or less, has both automatic overcurrent and short circuit protection for branch circuits. Combined thermal and magnetic characteristics give greater speed in tripping. Protection of circuits of 10, 20 and 30 amps. conforms with new Code Wire Ratings. Trumbull Electric Mfg. Co., Plainville, Conn.

D-C Motors

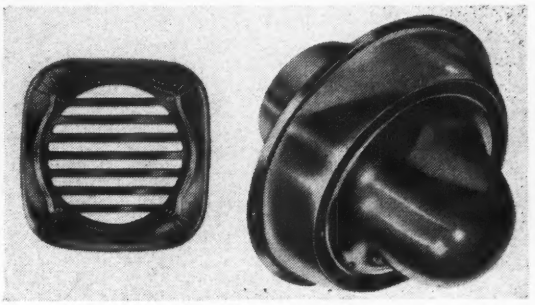


G. E. MOTOR

Unit cooled, totally enclosed, d-c motors designed for operation in severe atmospheric conditions such as prevail in steel mills, cement and paper mills and coal and coke plants are announced with dual ventilating systems, which utilize a compact unit cooler, operating on the auto radiator principle, using air instead of water for cooling. Although enclosed, vital parts are accessible for periodic maintenance and inspection. Constant speed motors are available with shunt, stabilized shunt or compound windings. General Electric Co., Schenectady, N. Y.

Electric Ventilator

Switch operated Kitchen-Aire ventilator is free of doors, shutters. chains and rods to manipulate. Outside mounting minimizes operating noises. Motor cover and deflector offers protection against rain and snow. Housing is of aluminum. Mounting may be either wall or ceiling located. Only a six inch round opening through the wall is required for installation. Exhaust passes through an unrestricted opening instead of over the motor, minimizing the fire hazard from grease coming in contact with operating motor. Stewart Mfg. Co., 3209-11 East Washington St., Indianapolis, Ind.



STEWART VENTILATOR

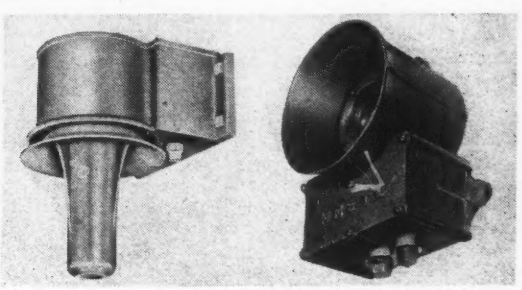
Expansion Anchor

S-A ANCHOR

Cadmium plated, super-expansion anchor has guaranteed strength to outlast the screws that are used in conjunction with it. Recommended for electrical, plumbing and bathroom fixtures, carpeting on concrete, stairs or marble. S-A Manufacturing Co., 11080 Gratiot Ave., Detroit 5, Mich.

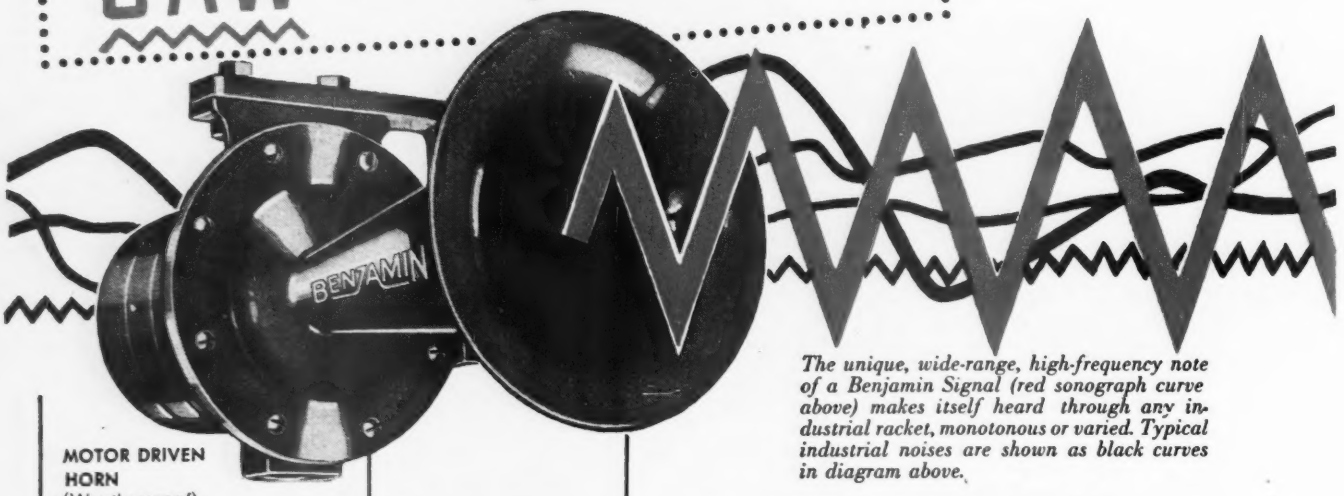
Explosion Proof Loudspeakers

Two new explosion proof loudspeakers are built of aluminum castings and equipped with permanent magnet dynamic driver units. Model MSR, with a dispersion of 360 degrees, consists of a reflex air column horn. The housing is hermetically sealed and provides mounting facilities for a constant-impedance attenuator and a line matching transformer should either be needed. Model MM-2TC is a lighter directional speaker with a dispersion of 120 degrees. Both models will function under water, drain automatically and operate with minimum maintenance. Reflectors are removable. University Loudspeakers, Inc., 225 Varick St., New York 14, N. Y.

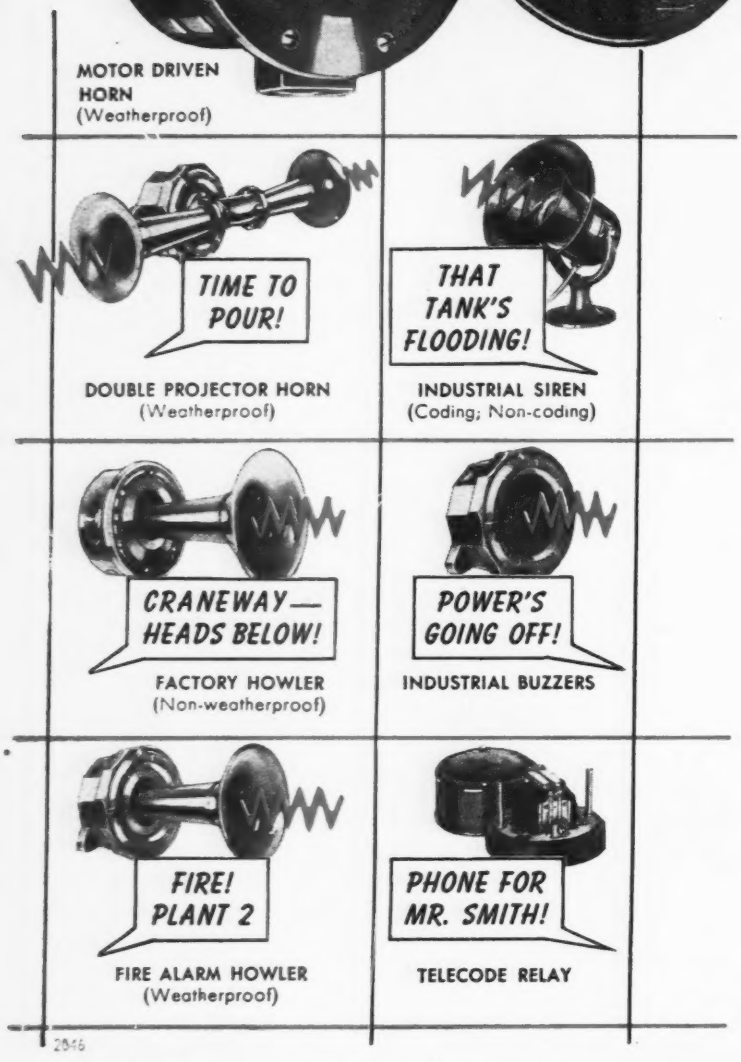


UNIVERSITY SPEAKER

They Warn, They Page, They SAW Through ANY Din!



The unique, wide-range, high-frequency note of a Benjamin Signal (red sonograph curve above) makes itself heard through any industrial racket, monotonous or varied. Typical industrial noises are shown as black curves in diagram above.



FOR executive paging—To locate quickly the men whose duties take them through the plant.

FOR telephone signaling—where noise drowns the phone bell.

FOR alarms and warnings—calling guards or firemen to the right place, for warnings of overflow, breakage and interruptions.

FOR time signaling—process-flow notices, hours-of-work signals.

One of these days, one slight accident to men or equipment will far more than overbalance the cost of a Benjamin Signal installation. Too, a Benjamin Signal installation cuts out the perpetual confusion, delay and annoyance of hunting for wandering, wanted personnel... a real contribution to operating efficiency.

You need such a system, you need *THIS* one, because the attention-getting voice of a Benjamin Signal can be depended upon to saw through any industrial noise; to produce a sound volume that is audible over a large area; and to be ruggedly constructed and especially designed for industrial and commercial service.

Draw on 30 Years' Signal Experience!

Benjamin horns and buzzers have been used for over 30 years in calling, warning, and paging signal systems in thousands of industrial plants. Pitch and volume are right for every use, relays and parts are made to the very highest standards. Let Benjamin Engineers help you obtain greater efficiency, better protection, a reduction in the accident rate, and savings in time and labor, with Benjamin Signals. Write for data!... Benjamin Electric Mfg. Co., Dep't H, Des Plaines (Chicago Suburb), Illinois.

Benjamin signals are listed by the Underwriters' Laboratories. They are available for A.C. or D.C. operation, in a wide range of voltages and cycles. Many can be had with choice of Double or Single Projectors.

A feature of Benjamin Vibrating Horns and Buzzers is the ease of servicing due to their unique construction which permits removal of the entire operating mechanism without touching the wiring.

Benjamin Telecode Relays are specially designed for connecting horns to telephone ringer circuits to replace bells in noisy locations where telephone bells can not be heard. For complete data, write for Bulletins.

BENJAMIN

SIGNAL AND ALARM SYSTEMS

Distributed Exclusively Through Electrical Wholesalers

Overload Protective Devices—Part II

The second of a series of articles reviewing circuit protective methods. This article discusses circuit breakers and relays.

By C. F. Hedlund
Electrical Engineer
Associated Factory Mutual Fire Insurance Companies, Boston, Mass.

ELECTRICAL AND MANUAL OPERATION

Circuit breakers may be either electrically or manually operated, or both. The majority are manually operated with a hand lever, while they may also be equipped with solenoids or motors and controlled electrically from remote locations. The manually operated type are most commonly arranged to trip automatically by overcurrent or under voltage attachments. The electrically operated type may have these and various other automatic features, as will be described later.

A "trip-free" circuit breaker is one that will trip open on overcurrent or other abnormal conditions for which the breaker may be equipped, regardless of the position of the operating handle or the electric closing mechanism. This will prevent the breaker being held in the closed position while an abnormal condition for which the breaker is equipped to protect against exists in the circuit. Most modern breakers are "trip-free".

METHODS OF TRIPPING

The smaller breakers in the industrial field are most frequently arranged to trip automatically on over current, either instantaneously or after a definite time interval or on undervoltage. Tripping on overcurrent is usually accomplished with series overcurrent trip coils built into the breaker. A solenoid plunger on the series trip coil acts directly on a trigger which releases the latching mechanism of the breaker when an overload occurs.

Other methods for automatically tripping the oil circuit breakers of the larger sizes are by means of potential trip coils or current trip coils in conjunction with protective relays. The main difference between the two types of trip coils is in the magnitude of the current and voltage which is used to activate the trip coil. The "potential" trip coil is so-called because it is connected across the potential of the control circuit and carries very low current.

The "current trip coil" is connected in series with the tripping circuit and has a low potential drop, receiving its energy from the secondary of a current transformer in the main circuit.

The most reliable method of tripping is by means of direct current potential coils, which are energized from storage batteries or a reliable source of power as shown in Figure 5.

Because the source of power required for tripping is the same as that which supplies the circuits or equipment which the breaker is intended to protect, it is not the best practice to use a-c potential coils for tripping the circuit breaker because under fault conditions the voltage of the system may fall off so low that the breaker cannot trip.

However, sometimes there is no reliable source of tripping current available and other means of tripping must be used, such as circuit closing overcurrent relays connected to the secondaries of current transformers in the main circuit. The relay contacts are normally open, but close on overcurrent and connect the current trip coils across the resistors which have a voltage drop across them sufficient to trip the breaker.

The simplest method when instan-

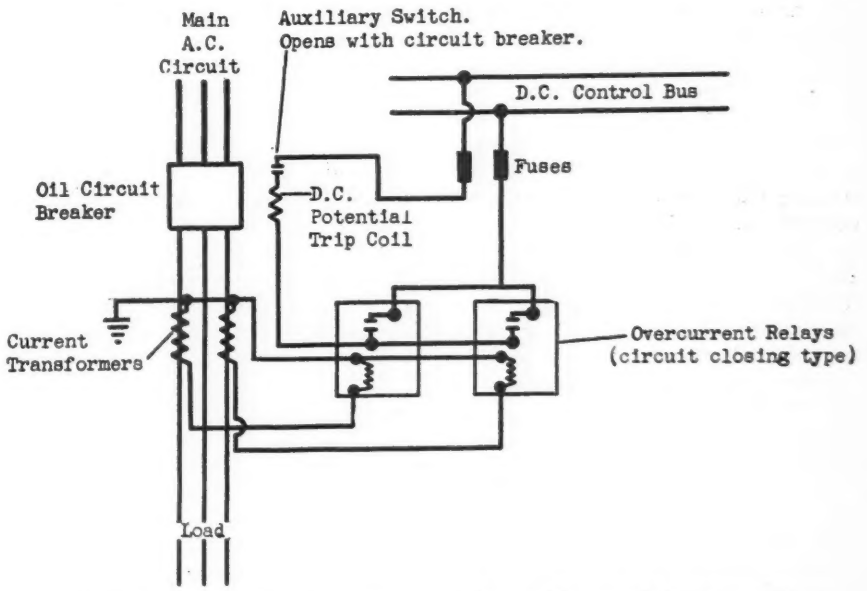


FIG. 5—Connections of overcurrent relays with potential trip coil—preferred method of tripping.

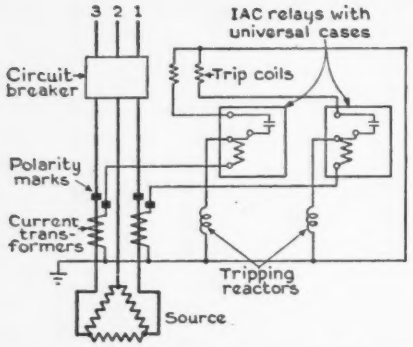


FIG. 6—Connection diagram of IAC overcurrent relays used in conjunction with tripping reactors for protection of 3-phase, delta-connected circuit.

taneous tripping on overload is desired, other than the series overload trip coils mentioned, is by means of current transformers in the circuit, the secondaries of which are connected to trip coils at the operating lever.

Most protective relays operate with normally open contacts in the control circuit and the trip coils are not energized until those contacts are closed. In some cases it is necessary to use an auxiliary relay of the circuit closing type in conjunction with the main relay to effect tripping. Circuit opening relays are also available but are not so widely used because the current interrupting ability of the contacts is limited.

If some form of protection other than overcurrent is desired or a more accurate form of time-delay is needed, relays are required.

INSTANTANEOUS AND INVERSE TIME LIMIT TRIPPING ATTACHMENTS

Circuit breakers may be equipped with an overcurrent device which is designed to open the breaker the instant the current reaches the point at which the breaker is set to trip. This is known as the instantaneous overcurrent trip. However, it is frequently essential, as in the case of starting a large motor, that the breaker carry the overload for a short time and for these conditions the inverse time limit overcurrent trip is provided. This attachment regulates the time of tripping inversely with the amount of overload, that is, the greater the overload the quicker the breaker is caused to trip.

UNDERVOLTAGE TRIP

The purpose of the undervoltage trip is to open the circuit in the event that the voltage falls below a predetermined value or fails completely. For example, in the case of a motor normally started at reduced voltage, if the power should fail momentarily and the motor stop or slow down as a result, the windings would be subjected to dangerous current when the power was restored if the circuit breaker or the motor controller had no such protective device. This device may be arranged for tripping the breaker instantaneously or with time delay.

SHUNT TRIP

It is often desirable to trip a circuit breaker for other reasons than those provided for by the various attachments mentioned above. For instance, limit switches or overspeed devices on various types of machinery may be arranged to energize the circuit through the coil of a tripping magnet which operates an armature that in turn releases a latch on the tripping mechanism of the breaker and causes it to open. This is known as the shunt trip and any number of breakers so equipped may be opened simultaneously if so desired and arranged for. An auxiliary contact is usually provided on the breaker which disconnects the magnet coil from the control circuit when the breaker opens so that the coil will not burn out. The d-c shunt trip coil is almost universally used on important large breakers.

A relay is a device that is operative by a variation in the conditions of one electric circuit to affect the operation of other devices in the same or another electric circuit.

These consist of two main types operating on different principles, namely, the induction and the solenoid-plunger types. They are inserted between the main circuit and the breaker.

The induction type relay operates on the same principle as the kilowatt-hour meter which is found in nearly every home today for measuring the amount of electrical energy consumed. It consists of an aluminum or copper disc which is arranged to rotate freely in a magnetic field produced by windings of the current and potential coils on a steel core. These windings are connected directly into the main circuit, or through instrument transformers to the main circuit, depending upon the magnitude of the current and voltages involved. The speed of the disc is governed by the flow of current in the coils. When used as an induction relay, a contact is fastened to the disc shaft and arranged to close a circuit through a trip coil when current causes it to swing around to a fixed contact. The disc, in the case of the induction relay, operates against the pull of a spiral spring. The time to close the contacts is regulated by fixing the disc in a certain position, and the amount of current required to turn the disc against the pull of the spring is adjusted by connecting to various taps in the coil winding. If the contacts and the spring were removed to allow the disc to rotate freely, we would have a rough form of induction watt-hour meter. The time-delay feature is adjusted by moving retarding magnets in or out on the

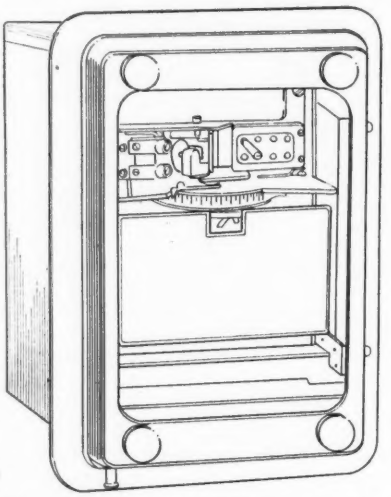


FIG. 7—Typical induction type time overcurrent relay.

revolving disc. Fig. 7 shows a relay of the induction type.

The solenoid-plunger type relay, Fig. 8, operates on the principle of an electromagnet. A plunger with fixed contacts on one end is caused to move up and down within the core of a solenoid and close or open fixed contacts in the control circuit depending upon the type of duty which the relay is designed to perform.

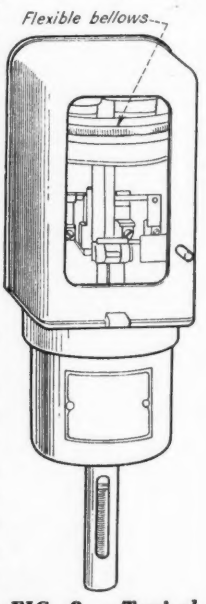


FIG. 8 — Typical solenoid plunger type time overcurrent relay.

The solenoid-plunger type relay may be designed to trip instantaneously or after a definite fixed time. The position of the plunger regulates the tripping point of the relay, as more current is required to raise the plunger from a low position than when it is higher up. The tripping point is adjustable by regulating the position of the plunger by means of nuts or thumb screws.

Definite time-delay in tripping is accomplished by means of an oil dash pot affixed to the bottom of the

plunger, or by means of a flexible bellows attached to the top of the plunger as shown in Fig. 8. Both of these devices, that is, the oil dash pot and the flexible bellows, accomplish the same result in retarding the movement of the plunger.

TIME LIMIT RELAYS

Time limit relays are divided into two classes: the definite time limit and inverse time limit. The inverse time limit is so called because the time delay in opening the circuit is in inverse proportion to the extent of overload up to about 1000 percent of normal load. Beyond this point the relay becomes a definite time relay.

The definite time relay, as its name implies, is one in which a purposely delayed action of a definite period of time has been introduced which will remain constant regardless of the operating forces acting upon it.

OVERCURRENT OR OVERLOAD RELAYS

These relays are designed to open a circuit breaker at any predetermined value of current above normal that is desired. They are available in both the solenoid-plunger and the induction types and may have either instantaneous or time-delay characteristics as desired. Figs. 5 and 6 show two methods of connection of induction time overcurrent relays.

A directional overcurrent relay is an induction type relay designed to operate only when power is flowing in a predetermined direction to protect circuits and apparatus against phase and ground faults in transmission lines and prevent unnecessary tripping and loss of load during momentary reversals of power.

REVERSE ENERGY RELAYS

The purpose of these relays, which are of a directional type, is to prevent current from flowing to a fault in the opposite direction to which it normally flows, such as might happen when a fault occurs in a generator operating in parallel with an external source of power, or two or more generators operating in parallel. This type of relay operates on the induction wattmeter principle and contains both current and potential coils and will cause the circuit breaker to open only when the flow of current is in the reverse direction to normal. It will not operate on overloads in the normal direction of current flow.

DIFFERENTIAL RELAYS

There are several types of differential relays which are known as ratio, balanced, or percentage differential relays, but they are all of the induction type and operate on the principle that the current entering a section of cable, transformer, or generator winding is normally equal to that leaving except when faults develop. A percentage differential relay is shown in Fig. 9.

(A double wound plunger type relay may also be used with the differential scheme of protection but as this is used very little it need not be further discussed here.)

These require two current transformers in each phase of the circuit as shown in Fig. 10.

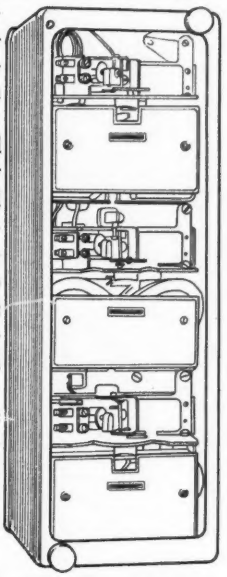


FIG. 9 — IJD12B triple-pole percentage differential relay.

They are connected so that under-normal conditions the current from each current transformer passing through the restraining coils No. 1 and No. 2 is additive, but as soon as a fault develops in the part of the circuit encompassed by the two current transformers, the current passing through one of the restraining coils becomes less than the other and the difference flows through the operating coil, causing the contacts of the relay to close and the circuit breaker protecting the apparatus to trip.

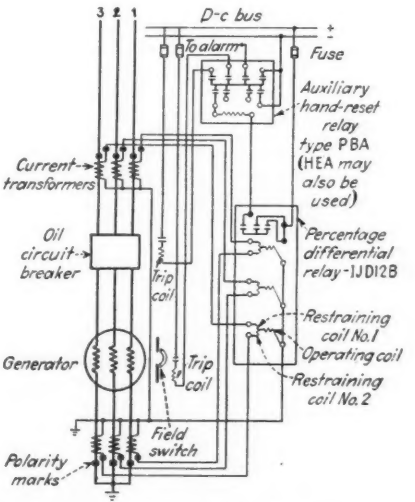


FIG. 10—Connection diagram of IJD relay for current-differential protection of a Y-connected 3-phase machine.

A differential relay will not operate on external overloads or short circuits, or any trouble occurring outside the zone of protection which is limited by the location of the current transformers.

The current transformers which are installed in each phase on each side of a generator or power transformer which are to be protected with differential relays are selected so that equal secondary currents will flow under normal conditions. Auto-transformers are sometimes used in the secondary circuit to balance any inequalities which may exist due to impossibility of obtaining ideal ratios in the current transformers.

UNDERVOLTAGE OR OVERVOLTAGE RELAYS

These are usually of the induction type and designed to protect apparatus against under or over voltage by tripping the circuit breaker or actuating other relays or devices, such as alarms. Operation of the relay on momentary changes in voltage is prevented by the inverse-time characteristics of the relay.

DIRECTIONAL GROUND RELAYS

This is an induction type relay, devised primarily for ground protection on grounded neutral power transmission systems, because experience has shown that line-to-ground faults occur more frequently than line-to-line faults. It is constructed with independent current windings on upper and lower pole pieces. There is normally no current in either winding, but when a ground occurs on one phase or more, a residual current flows in the upper winding from the line current transformers, and a current flows in the lower winding from the current transformer in the grounded neutral of the power transformer bank. If the current is of the correct polarity, the relay operates on the product of the two. If the fault is close to the station, the relay will operate very quickly as both the residual currents will be high.

THERMAL DEVICES

The most common and the most economical method of protecting motors against overload is by means of thermal relays, thermal cut-outs, or some device employing the heat, due to the increased current resulting from overloads in the circuit, to trip the motor starter or open the motor circuit in other ways.

Figure 11 shows the details of a starting switch for small motors which also provides overload protection. The thermal device incorporated within the switch consists of a small heater

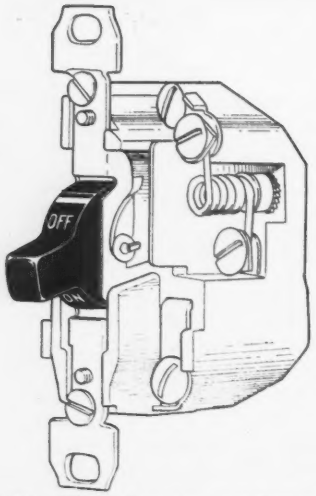


FIG. 11—Manual motor starting switch for fractional horsepower motors.

coil in the motor circuit, which surrounds a steel ratchet fastened to a fixed pin or shaft with a solder film. Heating of the solder film, due to overloading of the motor circuit, softens it and allows the ratchet to slip and disengage the tripping mechanism and open the main contacts. When the solder film cools, the overload device can be reset.

Caution: Care should be taken that the proper sized heater coil is used with such devices to correspond with the full load current of the motor in accordance with the manufacturer's instructions.

TEMPERATURE OVERLOAD RELAYS

Another older type of overload protective device for larger motors is the temperature overload relay often installed in the same case with the motor controller but also made in self-contained units.

These consist of one, two, or three overload elements consisting of a heating unit, a bi-metal strip, and a tripping device. Each heating unit is connected in a phase of the motor circuit, and heat from the unit is transmitted to the bi-metal strip. When an overload occurs the heat causes the strip to deflect and trip the contact mechanism or open the circuit through the holding coil. The speed and extent of deflection of the strip is governed by the severity and duration of the overload.

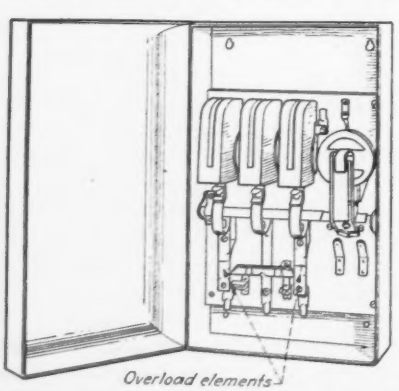


FIG. 12—Size 3, 3-pole magnetic switch in Type I general-purpose case.

The heaters are interchangeable and are made in different sizes according to the full load current of the motor that is being protected. When used on circuits higher than 600 volts, current transformers must be used with this relay.

THERMAL CUTOUTS

These have been used for many years but they are gradually being replaced by the more improved overload relays already described. They are designed principally for the protection of small motors up to about 7½ hp. and are found either in the same enclosure with motor starter or in separate metal cases.

The most common type is the plug type with screw thread base, usually left-handed, although they have been made in the cartridge type for motors having currents as high as 35 amperes at 250 volts. The plug type consists of a porcelain cup having either a screw base or slotted metal strip terminals for mounting in the starter box, and a removable cover with a mica window. Inside the cup is a perpendicular stationary contact post which carries a heating coil. A spring contact arm is held in deflection against the top of the contact post by means of a fusible link. The latter is made in two parts held together with a low fusing metal. The motor circuit is completed through the heating coil, stationary contact post, fusible link, and spring contact arm. When an overload occurs, the current through the heating coil heats the contact post, melts the metal, allows the parts of the link to separate, and the spring contact arm is released from contact with the stationary post, thus opening the circuit. The fusible links are replaceable with new links. Due to the time lag in the heating coil, the links will not open on the momentary heavy starting currents but will protect against overloads.

INHERENT OR BUILT-IN OVERLOAD PROTECTION

The National Electrical Code does not require running overcurrent protection for manually started motors smaller than one horsepower, but the desirability of such protection is well recognized, and some motor manufacturers have especially constructed their single-phase fractional horsepower motors with built-in overload protection.

Thermo-Tector. One overload device of this type is known as the "Thermo-Tector" made by the General Electric Company, and is installed inside the motor end shield in close proximity to the windings where it will be affected by the temperature of the winding. It consists of a fixed contact and a movable contact on the end of a bi-metal strip. The circuit to the motor is completed through the contacts which are closed when in the normal position. As soon as the windings of the motor become too warm, due to overloading, the bi-metal strip is deflected away from the fixed contact and the motor circuit is opened. It is made to reset either automatically or manually, whichever is desired. With the automatic reset type, the motor returns to the line as soon as it has cooled down to a safe temperature, at which point the contacts close automatically.

Thermoguard. The Westinghouse Company makes a similar device operating on the same principle, known as "Thermoguard". This is a built-in bi-metallic disc which causes normally closed contacts to open at a predetermined temperature. On a-c induction motors, it is usually mounted on the stator laminations, while on enclosed type or fan-cooled d-c and synchronous motors, it is attached directly to the windings. In the smaller motors, it is connected directly in the main motor circuit. In the larger motors started with circuit breakers and auto-starters, it is connected in series with the low voltage release coil. In some cases where it may cause considerable loss of production or serious inconvenience to stop the motor, the Thermoguard is connected up to ring a bell or light a pilot lamp.

Shop superintendent R. F. Groff, Hannon Electric Company, Canton, Ohio motor service shop, inspects a tote box in the newly reorganized small motor department.

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DATA SHEET

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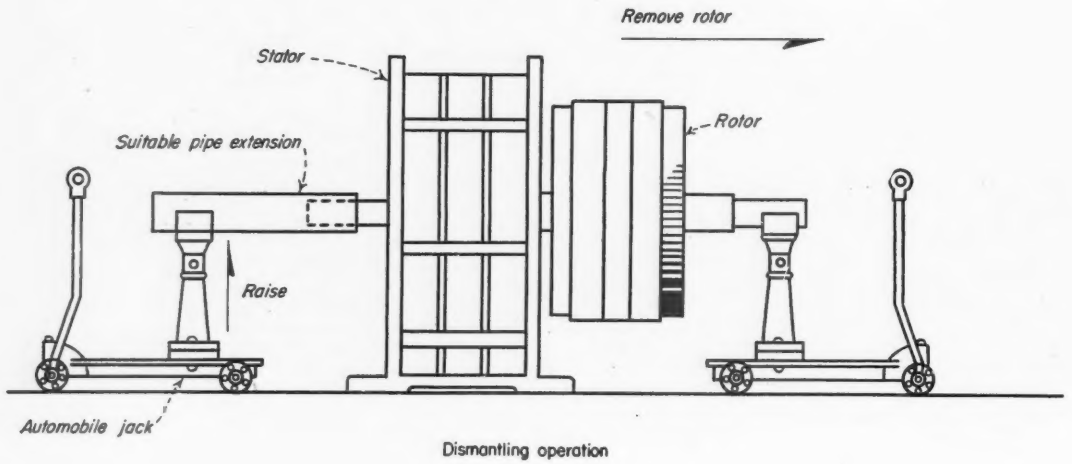
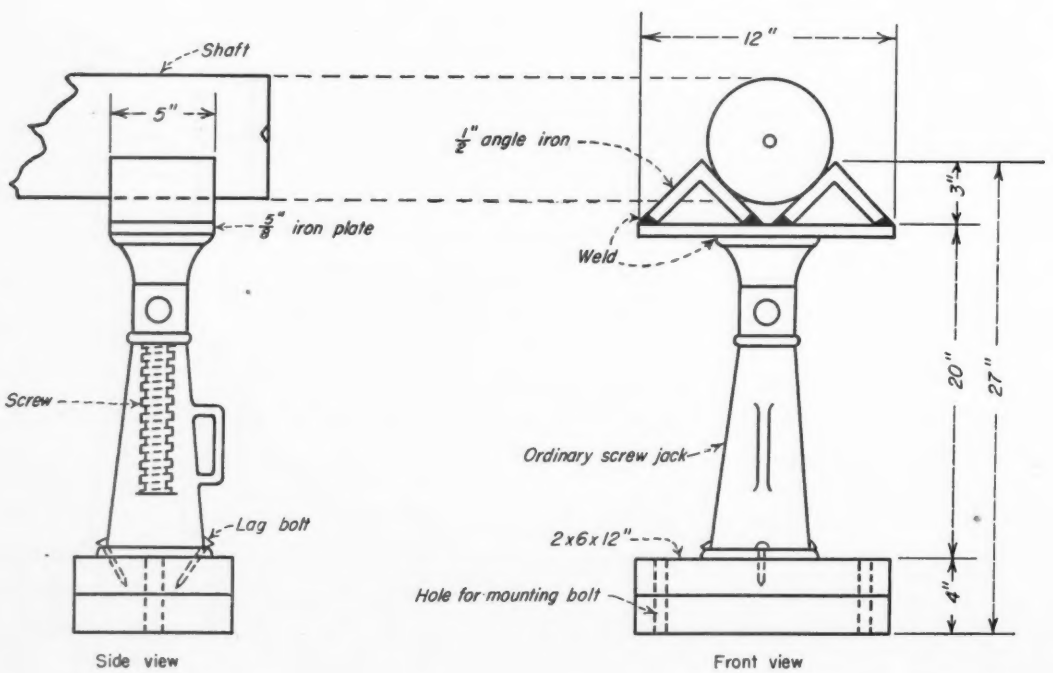
K-11

MOBILE MOTOR DISMANTLING JACKS

(Construction Details)



Dismantling operation



Side view

Front view

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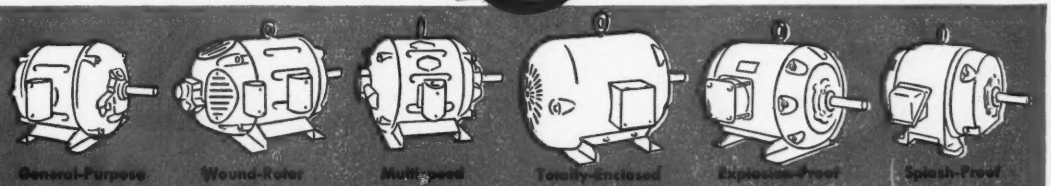
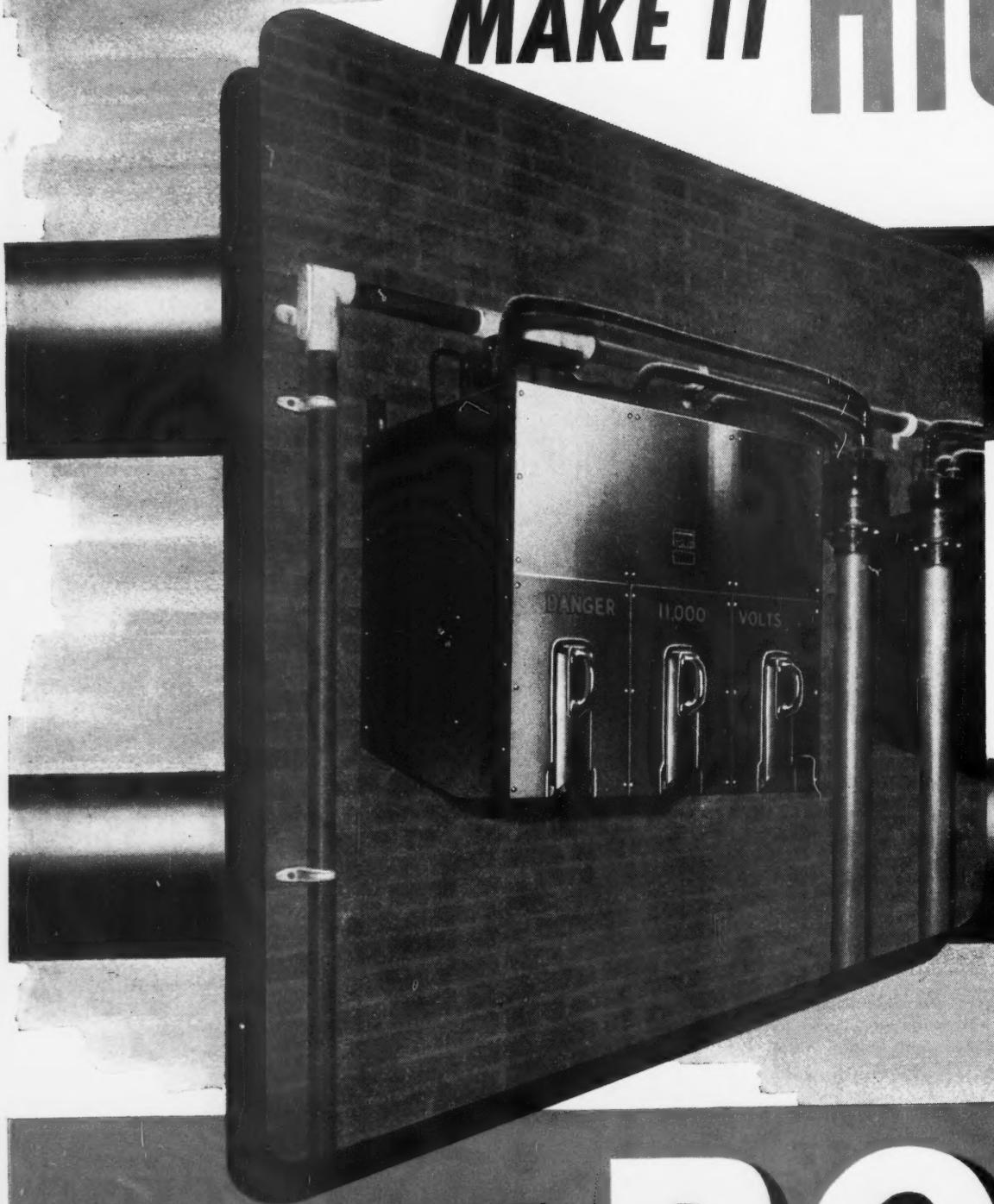


MAKE IT HIGH



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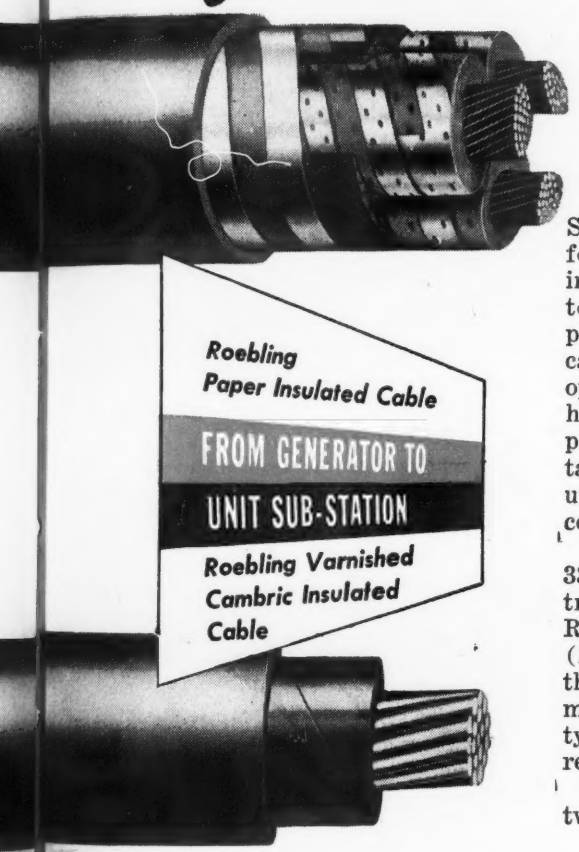

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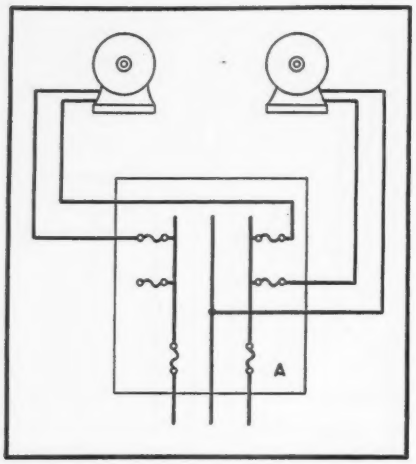
Reader's Quiz

Motor Protection

QUESTION 232—We have two small motors connected, as shown, on a three wire 110-220 volt a-c line. Is either motor likely to be damaged if fuse



marked A blows, leaving the two motors in series on the 110 v. line?—H.C.L.

A. TO QUESTION 232—I assume the two motors in question are wound for 110 volt circuit. It is stated that the opening of fuse at A results in the two motors being connected in series across 110 volts or, in other words, each motor now has ½ voltage applied to it. It is assumed that the two motors are running at full speed when the fuse blows. Since there is no change in frequency the speeds will be about the same but the maximum running torque or breakdown torque on each motor will be reduced about 50%. If both motors were heavily loaded this reduction in the maximum torque might cause them to stall. In this case, the only limitation to the current would be the resistance in their windings since the respective counter E.M.F. is now 0. If this condition was maintained, they would without doubt burn out. However, the increase in current would probably cause the other fuse to blow. Of course, a better arrangement would be to have a small circuit breaker which, in event of overload, would make a clean break of the entire circuit.—R.F.E.

A. TO QUESTION 232—This condition arising from taking 230 volt motors or equipment from 115/230 volt panels has caused considerable trouble in our plant and is now forbidden. There have been times when the main fuses have blown and times when only one has blown, as illustrated in the Question. This latter case has thrown all fixtures and motors on that side in series with the motor that was connected across the outside legs of the panel. This condition will and has burned out motors as the low voltage encountered on the so-called dead leg of the panel will not allow the motors to come up to speed, thus burning out the starting winding. It is the best practice to take 230 volt single phase off a three phase panel or if this is not practical to tie the single phase lines, through fuses, in ahead of the main fuses of the 115/230 volt panel.—L.R.D.

A. TO QUESTION 232—In answer to H.C.L., there *is* a chance for damage to the two motors accidently placed in series across the line. The motors will be operating at a reduced voltage and will be developing a torque far less than necessary to drive the connected load. This would cause the motors in question to stall, thus reducing the back EMF to a minimum. The result would be that the motors would tend to draw more current than normally expected, as shown by the formula:

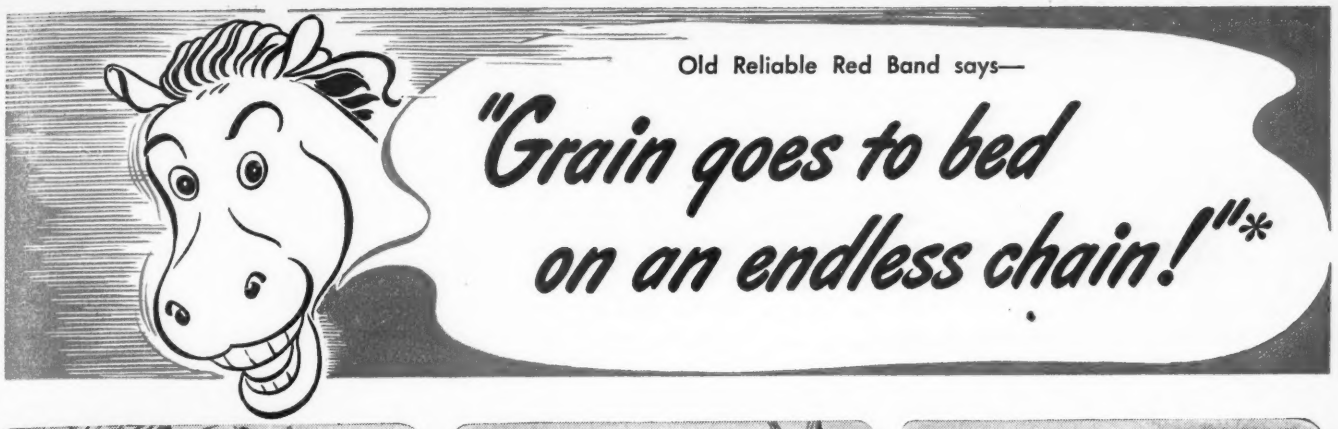
$$\text{Motor current} = \frac{\text{Line voltage - Back E.M.F.}}{\text{Impedance (of motors)}}$$

Normally the Back E.M.F. of a motor (Generator action in the motor) equals practically the line voltage, thus, under normal conditions the net voltage across the motor is very small. However, this Back E.M.F. is directly proportionate to the speed of the motor and if the motor speed decreases, the Back E.M.F. also is reduced. This has the effect of reducing a variable resistor and allowing a greater voltage across the windings. Thus, a stalled motor allows more current to flow than the windings are calculated for. This condition will also be true in the case of the motors in question.

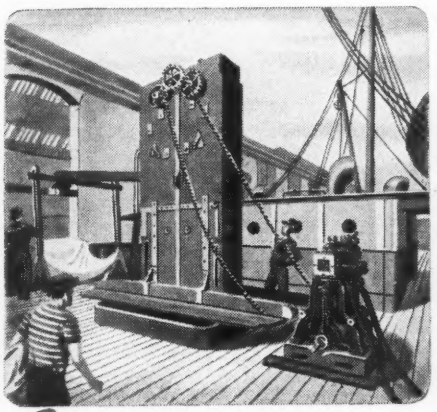
However, both motors have fuse protection of their own and if their values are low enough the motors will be spared the overload. If thermal overload protection is not now available, I would suggest the installation of suitable devices. Also, the replacement of regular fuses with 'time lag' or 'Fusetron' type fuses of a rating low enough to prevent damage to motors is possible.—W.R.S.

A. TO QUESTION 232—Yes, certainly, either one or perhaps both motors will burn out if they are near the same size. The blowing of this fuse while both motors are connected to the line leaves them in series across 110 volts. If the motors are loaded even lightly they will not run or will run so slowly that the current will greatly exceed normal at least for the motor with the smallest ampere rating. In case one motor has an ampere rating considerably less than the other its resistance may be so large that it will burn out and may open the circuit before the other is damaged. Also, if the 220 volt motor has a sufficiently great ampere rating—say twenty or more times that of the 110 volt motor—the latter will run and if not too heavily loaded neither motor will be damaged. Otherwise both motors will burn out. This is a particularly dangerous situation with automatic control. The motors may be protected by using a magnetic contactor as the control for each motor.—C.H.A.

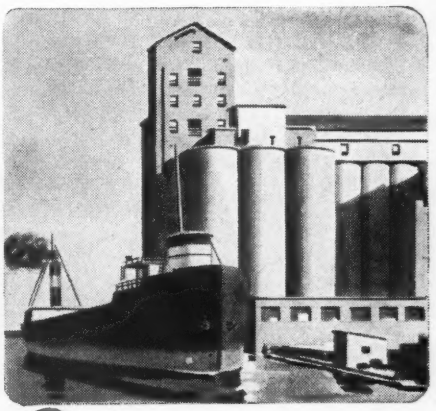
A. TO QUESTION 232—If the 110 volt motor draws normal current and operates at normal speed, which can happen when the 220 volt



1 Early American settlements had community granaries like those of Biblical times for winter storing of grain. In 1834, the first modern grain elevator was built in Buffalo. By 1866, bulk handling of grain was an established industry.



2 Chains of buckets were run, by cumbersome ropes and countershafts, from one central power source on the ground floor. In 1896 came the biggest improvement to date—individual motors were developed to drive each conveyor unit separately.



3 Today, with electrical horsepower, a Buffalo grain elevator can unload grain from lake carriers at the rate of 85,000 bushels an hour. Howell has been building specialized motors for grain elevators and other industries since 1915.

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(1) Precision-built of finest materials, with copper or bronze rotors, and completely insulated.

(2) Smooth-operating because statically and dynamically balanced.

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See your nearest Howell Representative for your needs in specialized or standard motors up to 150 h.p. Remember, you pay no more for industrial type Howell Motors—and you always get top quality for your money.

Howell Protected Type Motors available in sizes 5 h.p. and smaller. Also other sizes of Howell industrial type motors available up to 150 h.p.

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ELECTRIC MOTOR
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One of the many reasons why Johnson E M Bearings are preferred by so many leading Electric Motor Repairmen is the long, satisfactory service they deliver. This is possible because we cast every E M Bearing in a special high lead alloy (15%). This plastic quality enables the bearing to withstand frequent overloads and to compensate for slight mis-alignment. Our new catalogue will give you the details. Johnson Bronze Company, 490 South Mill Street, New Castle, Pennsylvania.

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Sound engineering, quality materials and precision workmanship for more than 25 years has resulted in wide-spread preference for TRICO PRODUCTS and guaranteed customer satisfaction!

Use this *proved* line to increase job quality and make more money by installing . . .

TRICO FUSES—for double protection and triple service.
KLIPLOK CLAMPS—to supply perfect contact between fuses and clips.
FUSE PULLERS—for safely removing and replacing fuses.
OILERS—for automatic lubrication of bearing surfaces.
AIR GUNS—to increase production, cleaning, etc.

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Fuse Pullers

Automatic Oilers

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Fuse Clamps

TRICO FUSE MFG. CO.
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motor is about 16 times as large as the 110 volt motor, then both motors will be safe. If the 220 volt motor will limit the current through the 110 volt motor to a value below the current setting of the 110 volt motor fuse, and the 220 volt motor fuse, and both motors do not run, then both motors will burn out. If the 110 volt motor is about 4 times as large as the 220 volt motor, and the 220 volt motor is slightly over fused, then the 220 volt motor will burn out, and the 110 volt motor will be safe. The main principle is that motors can carry a small fraction of the running current while standing idle.—H.S.

Transformers

QUESTION 233—We have a 440 volt, 3 phase bank of 25 cycle transformers connected closed delta on both primary and secondary. Our switchboard buses are fed from these with two 750,000 cable paralleled for each phase. Each of these cables is about 12 feet in length and the one with which it is paralleled is about 1 foot longer. We get the following amperage reading per phase:

Phase 1	*1st cable*	*260 A*
	2nd cable	*320 A*
Phase 2	*1st cable*	*280 A*
	2nd cable	*330 A*
Phase 3	*1st cable*	*280 A*
	2nd cable	*320 A*

These transformers are all 25 cycle, 200 kva., Type H, Form KDD. We are using these on 60 cycle. Why do each of these cables which go to the same bus or phase have such a difference in amperage reading? Does the difference of 1 foot in length account for this?—H.W.

A. TO QUESTION 233—I believe that H.W. has a condition similar to one which we have encountered in one of our bus structures. We have a three phase four wire bus which we are unable to load to capacity because the impedance of the individual legs is not the same due to arrangement of the bus copper with respect to the supporting structure.

Due to the fact that H.W. has six 750,000 cables installed it may be that his spread is so great that he is losing some of the neutral effect of the three phase set up and it will be necessary to bring them into a closer arrangement to get it.

If he is able to transpose the cables once in the twelve foot run he will probably get nearly balanced current readings also. If the transposition is

LOOK TO WARE HI-LAG FUSE FOR PRODUCTION PROGRESS

WARE HI-LAG *Renewable* FUSES

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The reasons for WARE HI-LAG Super Performance are—higher lag for starting loads and surges—greater strength and durability—link designed for maintaining low resistance—non-heating, spring tension contacts with greater contact area. These are features which save time, expense and renewal costs. Start economizing! Try WARE HI-LAG Today!

Write for Brochure giving details of all the COOL FACTS, sizes and prices.

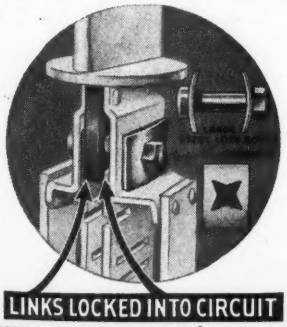
Cool Facts No. 3

NON-HEATING CONTACTS

The wide contact surface maintains low contact resistance.

Spring tension on links locked into position, prevents loosening of contacts, which causes over heating.

Connections held firm by large arched spring steel washers and heavy bolts.



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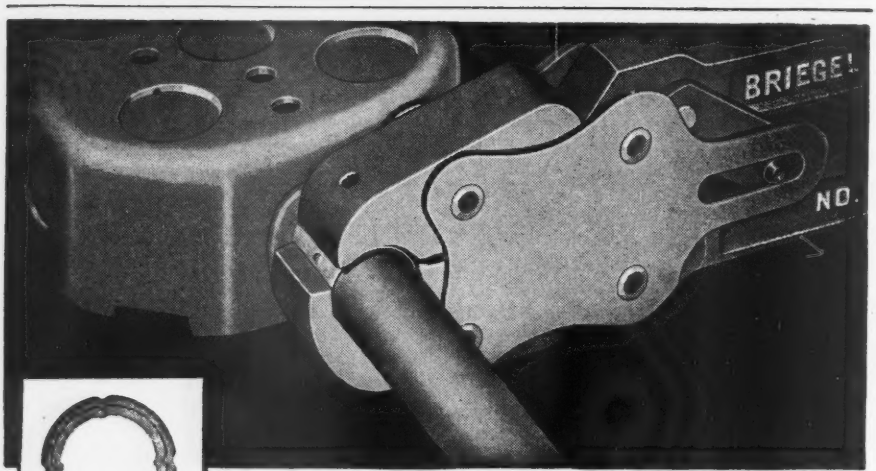

Cross section Showing Indentations.

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Two Squeezes and it's Set

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(All B-M Fittings carry the Underwriters Seal of Approval)

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attempted, it will be necessary to have all three cable legs change position.

H.W. can check this condition by wrapping some soft transformer iron around the cable giving the high reading. If it is a question of impedance, he will be able to crowd the current into the low reading cable and approach a balance.

If I read the question right, the longer cables are the ones which show the higher current and longer length should mean higher resistance and lower current.—C.A.W.

A. TO QUESTION 233—Two very important principles are involved, "The resistance of a conductor increases in proportion to its length and inversely proportional to its cross-section" and, "The current in a divided circuit will divide inversely proportional to its resistance and again unite," I would say the 1 foot would cause this difference of current in the paralleled wires. However, as each phase does not have the same proportion of current division, this could be laid to the wire measurements not being identical, therefore the formula

$$LD = \frac{2K \times L \times I}{CM}$$

should decide these differences in current divisions, and too, the impedance of each wire is slightly different—J.V.H.

A. TO QUESTION 233—In case two conductors or two parts of an electrical circuit are connected in parallel, the currents vary inversely as the impedances of the two parts of the circuit. The statement in this case is that for each phase one conductor is 12 feet in length and the other about 1 foot longer or 13 feet. I assume that in each phase the larger current (2nd cable) flows through the conductor or cable which is 12 feet long. If the only difference in impedance is due to the difference in length, it would be $\frac{1}{12}$ or about 8 percent. Other factors will affect the impedance—contact resistance may be greater in some cases and also the reactance (due to inductance) may vary. Since the currents vary from 12 to 19 percent less in the first cable in each case, it seems there must be some variation in reactance. If one cable is in conduit or raceway and the other is open, this may make the change.—J.E.W.

A. TO QUESTION 233—When you parallel the two 750 MCM cables and use different length wires, as you have in this case, the current will divide between the two conductors inversely proportionate to their respective impedances. The impedance in this case is unknown except

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KIRKWOOD dependable *COMMUTATORS* insure against service failures. Engineered for accuracy — precision machined to bore and diameter — bars that won't throw — high grade mica — heat treated to reduce expansion and excess mica binder — *KIRKWOOD COMMUTATORS* will withstand the most severe changes of vibration, heat and speed.

Engineering skill and the finest production methods guarantee *KIRKWOOD* built-in quality.

Prompt shipment from stock can be made on commutators for refrigeration, commercial or vacuum cleaner motors, and automotive types.

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MACALLEN MICA is the universal choice in every shop doing quality, guaranteed motor service work. *MACALLEN MICA* has the highest dielectric strength of all easily worked insulation materials and is unaffected by heat.

Manufactured under exacting production controls to insure perfect accuracy, *MACALLEN MICA* is furnished in sheets in all thicknesses and sizes for moulding and cold forming, segments, and in every other form required for all shop needs.

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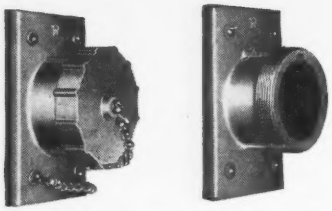
Watertight Plugs and Receptacles

WITH TRIPLOC CONTACT UNITS



Receptacles for FS-FD Pylet bodies

Watertight Plugs

These substantially built plugs and receptacles are equipped with Triploc contact units and are watertight for use as floodlight connections or for any other type of portable electrical equipment where weather protection is needed. Types include 1, 2, 3, 4, 6, and 8 pole units. Receptacles are galvanized cast iron with brass cap. Plugs are cast aluminum alloy with threaded nut and rubber bushing cord grip. Female contact units can be mounted in plug shell as well as in receptacle housing, as all contact units are interchangeable and reversible. For any type of outdoor plug and receptacle connections refer to your Pylet Catalog for complete listings.

THE PYLE-NATIONAL COMPANY

1344 N. Kostner Avenue, Chicago 51, Illinois

the resistance part, which is probably the greater part of the total impedance. The one foot difference in length in this case is a difference in resistance and, consequently, a difference in impedance of about 8 percent. Other factors would change the total impedance, and it is quite probable that the one foot difference in length will cause the difference in currents carried in the respective conductors. In other words, the resistance of the 12 foot cable is 92½ percent of the resistance of a 31 foot cable. The currents in the first cable are 81.5 per cent, 85 percent and 87.6 percent, respectively, of the currents in the second cable. As the one foot is stated as being about one foot, and as terminal resistances, lay of the cable in the conduit and other factors will also make a difference, it is practically impossible to obtain an exact equal division of currents in short conductors such as you have in this case. You will note further that the currents between the phases are not evenly balanced—the current in phase one totaling 580 amperes; phase two, 610 amperes; and phase three, 600 amperes. The difference in currents in the first and second cables is entirely in order.—L.R.B.

Can you ANSWER these QUESTIONS?

QUESTION R-10—Under what conditions can a two speed, 3 phase, a-c motor, 850 rpm. and 1150 rpm., winding be reconnected for 220 volts from the original 40 volts? Or is complete rewinding the only alternative?—E.J.K.

QUESTION S-10—What will cause a single value capacitor type, squirrel cage motor, operating as a bench grinder, to fail to start at a certain position of the rotor? Moving the rotor a small fraction will cause it to start. The motor is ¼ hp., 110 volt, 60 cycle, 3.8 amps, operating at a speed of 3450 rpm. The capacitor is rated at 8 M.F.D.—330 volts. How is this value of capacitance arrived at? In substituting capacitors would it be safe to use the formula:

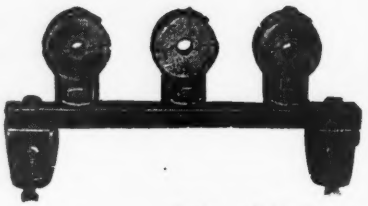
$$\text{M.F.D.} = \frac{2650 \times \text{amperes}}{\text{applied volts}} = \frac{2650 \times 3.8}{110} = 91.\ \text{M.F.D.}$$

New bearings and a new capacitor of the same value have been installed with the same result. A capacitor of much higher value, 400-450 M.F.D., 110 volts, was tried and the motor took right off, but seemed to have poor pull-in torque.—E.J.M.

PLEASE SEND IN YOUR ANSWERS BY JANUARY 15

NEW!

Non-Inductive Conductor Racks



Racks available for any number of cables — cable sizes 5/16" to 2⅜".

● Available in types for any number of cables, the M & W Types S-L Conductor Rack is designed so that cables are only partially surrounded by metal. This prevents induced current—permits the rack to be used for A.C. or D.C. systems. Simple design makes for quick, easy mounting of cables.

Write today for Bulletin C-5-51 . . . contains full information on M. & W. Non-inductive Cable and Conductor Racks.

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ELECTRIC MFG. CO.

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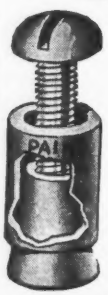
PAINE ANCHORS Hold Fast

IN MASONRY AND CONCRETE

LEAD EXPANSION TYPE



Solid support for securing fixtures against shock, stress and vibration.

Machine Screw Type (900) — is available in 9 standard diams. from 6-32 to ⅝" in standard lengths.

Bolt and Nut Type (910) — is available in ¼", ⅜" and ½" diams. in standard lengths.

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THE PAINE CO.

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★ PAINE ★ FASTENING and HANGING DEVICES

TREATED BRUSHES

[FROM PAGE 64]

been outstanding in favor of the treated brush which should be considered for such machines that may be giving troublesome commutation but which are not in a highly corrosive atmosphere.

There were very few cases where commutation was worse with treated than with non-treated brushes.

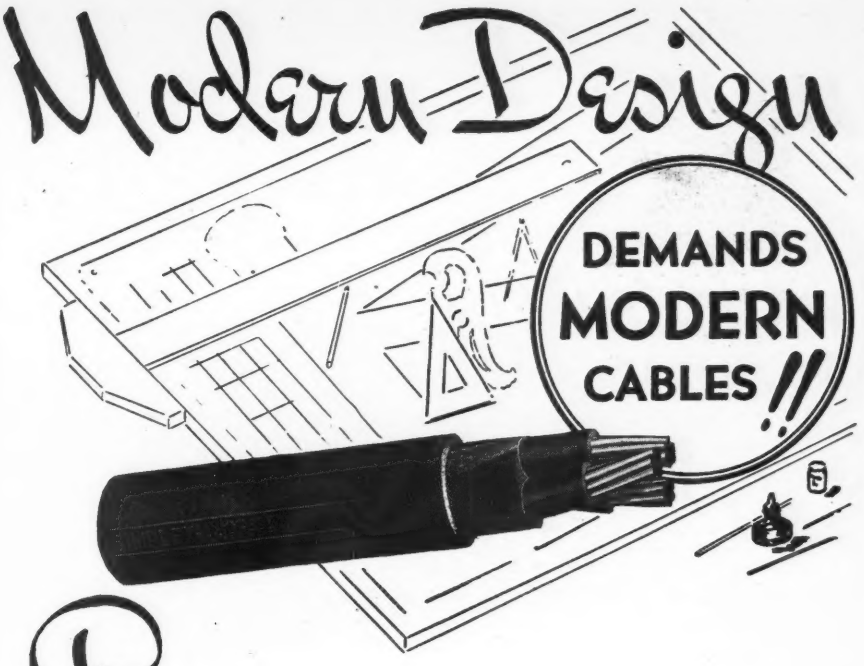
Local Conditions

The treated brush is a means to an end and should not be applied unless its use is clearly indicated. For example: There are a number of applications on which the film surface of the commutator may progressively build up, particularly over a long period of operation; or after a period may become stable and then for some reason become punctured. When this punctured hole of the film comes under the brush face the current will rush to this low resistance spot and enlarge the hole. This progresses circumferentially, and threading and grooving results. The treated brush can help this situation by repairing the hole before it gets too large.

Just as the treated brush cannot be expected to maintain the oxide film in corrosive atmospheres neither can it be expected to repair the evils of oil or grease upon the commutator surface. If an oil or grease film is deposited on the commutator surface, the action of current across this film may carbonize this organic material and leave carbon particles in the interstices of the commutator copper. These show up as a carbon smut that produces brush friction and brush chatter, a condition that gets progressively worse unless corrected. There is no cure for oil or grease on a commutator except to remove the cause.

Another means of prolonging brush and commutator life, as a parallel to application of treated brushes is the use of electrostatic or wet air filters to clean the air in large motor ventilation systems. Experience on several installations indicate that economics should be further studied for more general applications.

The research and design of treated brushes has been carried forward to accomplish definite aims under specific conditions. Intelligent utilization promises improved operation.



Plans for today's airport, building, and highway construction are thoroughly modern. They call for underground power lines, and with an eye on increased performance at decreased expense specify ANHYDREX* underground cables.

Simplex-ANHYDREX underground cables may be installed in ducts or buried directly in the soil without any outer coverings.

A tough rubber jacket provides protection against the injurious effects of abrasion and acidity, and eliminates the sheath currents and electrolysis common to metallic-covered cables.

The ANHYDREX insulation is the most moisture-resistant rubber compound known to the wire and cable industry and even constant immersion in water will not impair either its physical or electrical properties.

It never pays in savings or performance to be behind the times, but it will to specify ANHYDREX cables for your next construction job.

*Trade Mark Reg. U. S. Patent Office.

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SIMPLEX WIRE & CABLE CO. 79 SIDNEY ST. CAMBRIDGE 39, MASS.

HERE'S SOMETHING NEW IN "FIXED-SPEED" MOTORS

MORE COMPACT... LOWER PRICED

Synchronous motors no longer have a "corner" on *all* constant-speed applications. Smaller, less expensive R&M motors of the split-phase type now can be made so *uniform* in r.p.m. that they satisfy exacting speed and torque requirements.

NEW ECONOMIES

Usual off-the-line split-phase motors—and all other types, except the synchronous—may vary as much as 30 to 35 r.p.m. from *rated* speeds. That's why the added cost of synchronous motors *has been* justified; why their "bulk" was accepted as necessary. But now that R & M engineers have perfected a method of holding split-phase variation to less than *one-half of one per cent*, either way, the application picture has changed.

We don't mean to imply that this new development obsoletes synchronous motors entirely. That's *far* from true. Yet it *does* afford definite cost-saving and space-saving opportunities where operation permits a variation of, for example, plus or minus 5 r.p.m. in a 1763-r.p.m. motor. This is close enough for a *great many* uses which formerly were restricted to synchronous motors.

PROGRESS

Through close association with builders of all types of motor-driven machines, and long-time experience in developing and building special motors, R & M engineers have made many important contributions to *progress*. That's why, through the years, R & M motors have earned such an enviable reputation for *dependability*—why, today, more and more manufacturers are looking to R & M for the *new-that's-good*, combined with the tried-and-proved.

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Motor Shops

Retractable Growler For Shop Testing

One of the most common pieces of shop test equipment is the growler used for checking motor armatures. Practically every repair shop has one. Method of use and storage, however, varies with the individual shop. Sometimes it is stored under a bench or in a corner of the shop where it may accumulate a coating of dirt and grease; or the leads be subject to mechanical damage. Frequently, considerable time may be spent locating a misplaced growler when a test job comes on the floor.

Such conditions will not be found in the well organized shop where everything is always in its place ready for immediate use. Typical solution of the growler storage problem is found in the repair shop of the Maintenance Company, Inc., New York City. Here, a retractable arrangement keeps the unit suspended near ceiling height—out of the way but within easy reach of the workmen. Additional refinements include a reel (attached to the growler frame) on which the test leads are wound when not in use, and a clip to hold the saw-blade "feeler."

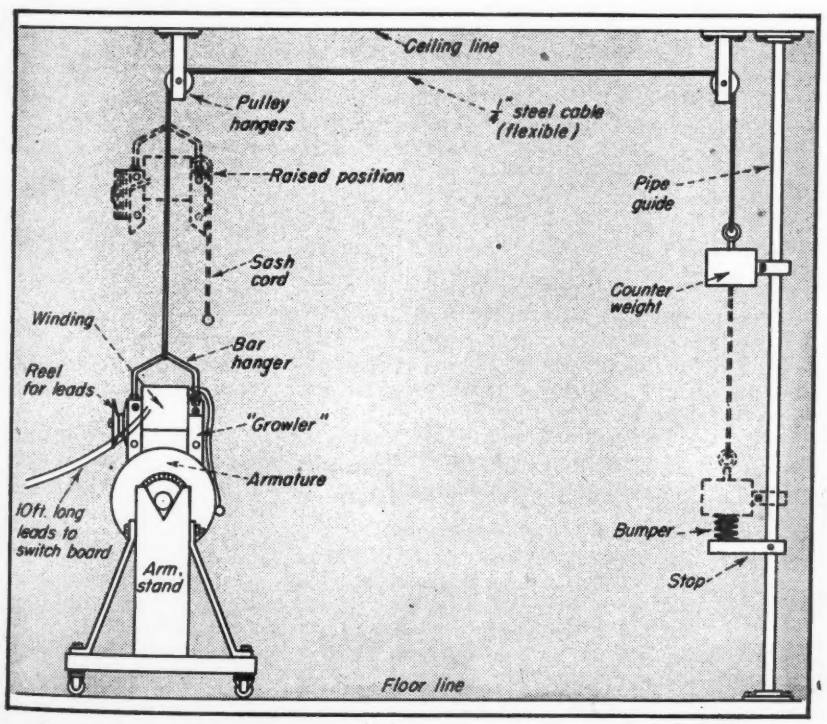
The idea, illustrated and developed by Charles Peters of the Maintenance Company, was submitted in last year's NISA Award Contest and recently released for publication by NISA headquarters.

A conventional growler was equipped with a stirrup bar hanger mounted by angle-iron brackets to diagonally opposite ends of the laminated core. A knotted sash cord, fastened to the hanger, permits a mechanic to easily reach the unit and pull it down to the operating position.

The retractable feature consists of a counterweight fastened to the stirrup hanger with a length of ¼-inch flexible steel cable which passes over one ceiling mounted pulley directly over the test position and a second one over the vertical travel of the weight. Slightly heavier than the total weight of the growler assembly, the counterweight is equipped with a collar that slides over a vertical guide stanchion (¾-in. pipe) supported by ceiling and floor flanges. A coil spring bumper on the guide stops the weight, and the growler, at a predetermined level.

An armature to be checked is rolled under the growler which is pulled down from its retracted position. The leads are attached to the switchboard—or other source of current—and the test proceeds. When completed, the leads are disconnected and wound around the growler reel; the "feeler" placed in its retaining clip and the growler assembly pushed up and out of the way. It remains in this position, complete with all its accessories, until again used.

Mr. Peters reports that one man can make the complete test without risk of accident and without the expenditure of time usually lost in looking for the unit and "feeler" blade, cleaning them when found, or making repairs to damaged test leads. The device has proved its worth as a time saver in the Maintenance Company's shop.



Counterterweight scheme suspends test growler up and out of the way when not in use. Reel on side of unit keeps test leads coiled and undamaged. Clip on side of growler holds "feeler" blade.

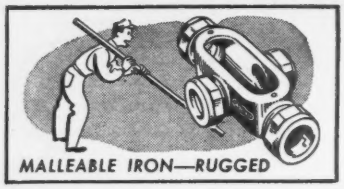
Heat Ring Speeds Commutator Repairs

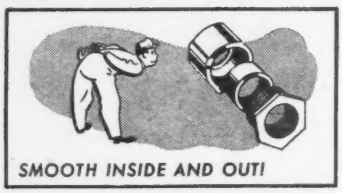
An electric heat ring replaces the conventional gas torches formerly used to apply heat to commutators at the Hannon Electric Company motor service shop in Canton, Ohio. Result: A considerable saving in time and effort; more uniform heating; less chance of damaging commutator; mechanic is free to do other work while commutator is being heated.

The device is a simple angle iron (1½ in. by 1 in.) ring, 30 inches inside diameter, with six 250-watt reflector type infra-red lamps mounted to the inner flange. A single circuit controls all lamps. Space is available for the addition of six more lamps in the future if more concentrated heat is desired. At that time a two-position switch can be installed to provide a double-range heat control. The complete assembly is chain supported at three points and suspended from a counterweight so it can be positioned at any desired height. The unit is fed by a flexible cord with plug for connection to an adjacent bench receptacle.

Most frequent application of the unit is for replacing mica V-rings on commutators. The rotor, with commutator up, rests on a wood platform (hole in center for shaft). The heat ring is then lowered until the lamps are in line with the commutator face. After

They make tough jobs easy because GEDNEY FITTINGS...FIT!





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What electricians and contractors want most in the fittings they use is smooth fit. They want conduit to thread in smoothly, caps to fit into place easily, screws to align and tighten evenly. With GEDNEY fittings the contractor knows his job will come out right. All GEDNEY fittings are packed in sturdy, metal-edged boxes that can't break open, and each package is clearly labeled for quick selection.

The fact that GEDNEY fittings have been on the "best seller" list with mechanics who know fine accessories is proof enough of year in—year out excellence. Check the other features in the panel at left. They highlight the points about GEDNEY fittings that mean money in the bank for "live wire" wiring men.

ASK YOUR WHOLESALER

WRITE FOR LITERATURE

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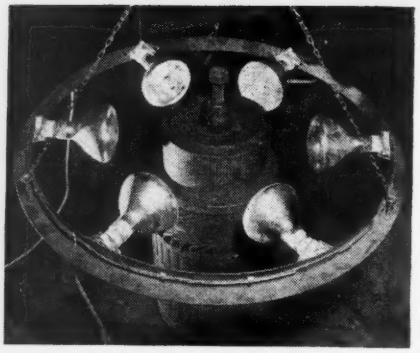


Circle of infra-red lamps heats motor commutator; speeds mica V-ring replacements; preheats for soldering. Counterweight suspension of unit permits positioning at any desired height.

the lamps have been on for 60 to 90 minutes, the varnish or shellac binding on the mica ring is soft enough to permit easy removal (after steel V-ring has been taken off).

The same procedure applies to replacement of the mica ring. After the steel V-ring has been drawn up to seat the mica, the commutator is heated sufficiently to soften the new mica so it will mold without cracking. Then the steel V-ring is again drawn up to make a final fit.

The infra-red ring, designed to accommodate commutators from 6-in. to 12-in. diameter, is also used for preheating the commutator bars when soldering is necessary and can be applied to many phases of motor repair work.

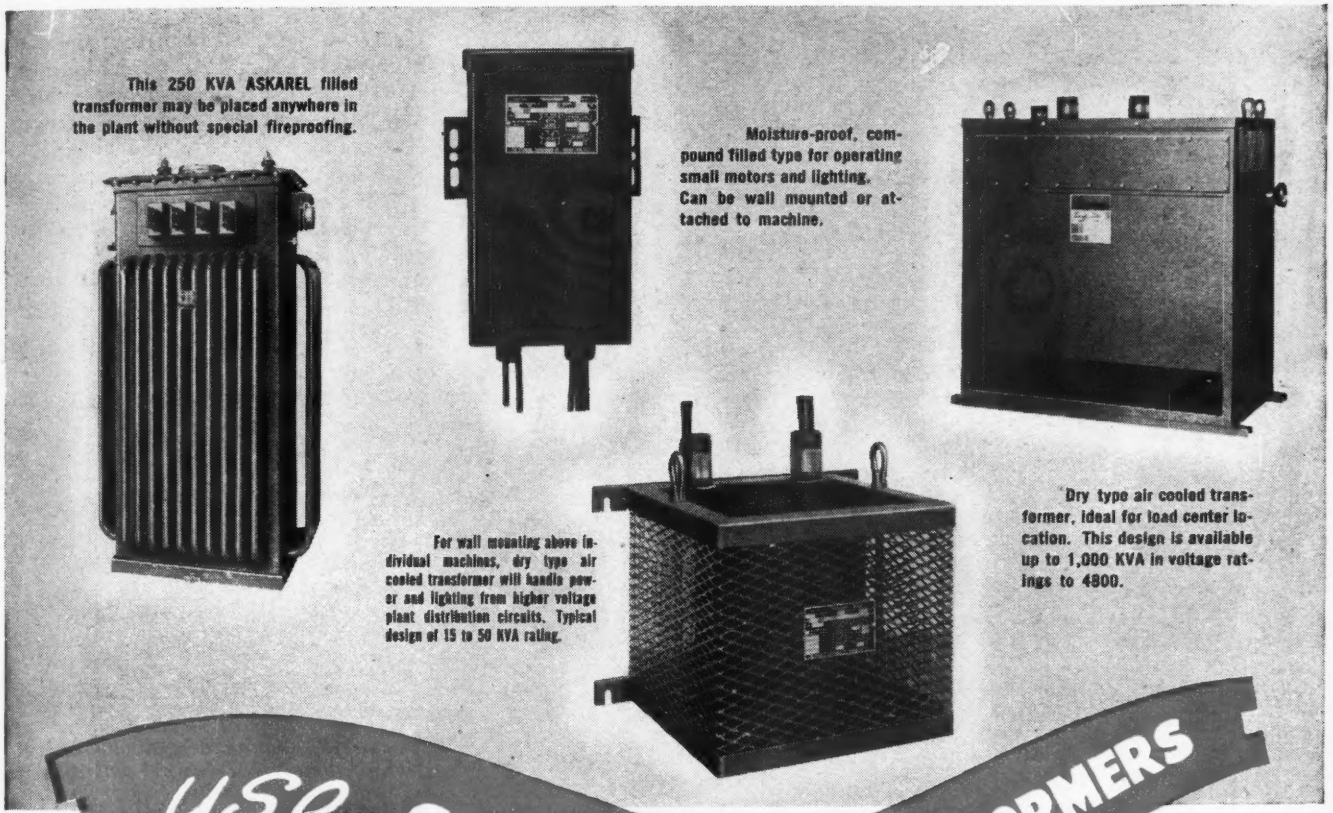
Grip-Tite Sleeve Bearing Extractor

Most motor shop operators know what a task removing sleeve bearings from motor end-bell castings can sometimes be. In most cases bearing removal requires considerable care and skill since the top or outside end-bell opening is usually large enough to permit only the rotor shaft to protrude. If the sleeve is tight, the problem grows. Frequently, difficult removal with a rod and hammer results in damage to the parts involved.

The Arthur Wagner Company, prominent Chicago motor service shop, has one answer to the problem—a simple, yet ingenious sleeve bearing extractor. The device was designed and built by employee William Embree who entered it in last year's NISA Award Contest and walked off with third prize honors. It is described herewith by permission of NISA headquarters.

The easiest way to understand the design and operation of the device is to refer to Fig. 1 accompanying this discussion. The following description

when *plant* conversion means *power* conversion



This 250 KVA ASKAREL filled transformer may be placed anywhere in the plant without special fireproofing.

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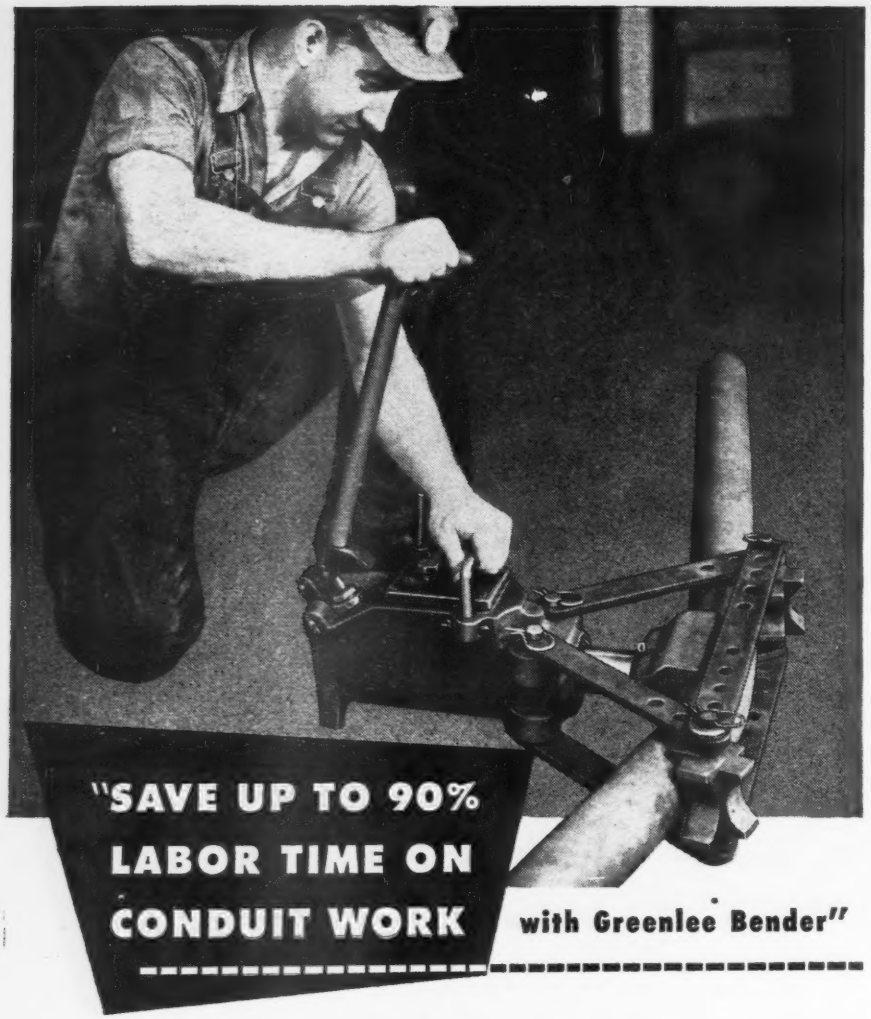

Yes, these great labor-savings... plus savings of about 50% on fittings and manufactured bends . . . are reported by G. B. Bolander, Chief Electrician and Maintenance Superintendent for the Buckeye Traction Ditcher Company, Findlay, Ohio.

"Our factory is full of examples where large timesavings are made with the GREENLEE . . . it is all a definite and unusual performance record," he further states.

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will embody references to the identifying letters on the cross-section sketch.

The bearing extractor consists of four basic parts: A square-threaded steel screw "C"; an inside-threaded, cone-shaped wedge "D" with a smooth exterior surface and gradual taper (this is threaded on center screw "C"); a sliding split sleeve "E" (three segments) with a serrated (large teeth) exterior surface and a tapered interior bore that slides over center screw "C" and expands when forced against cone wedge "D" (the outer teeth gripping interior of the sleeve bearing); and the hexagonal locknut "G" which firmly clamps together the complete assembly. Mr. Embree warns that the cone wedge "D" and split sleeve "E" should be fabricated from carbon steel, about 10-45, heat treated to increase hardness.

The extractor is simple to use. The center screw and cone wedge "C" and "D" are inserted in the bearing as indicated in Fig. 1. Split sleeve "E" is

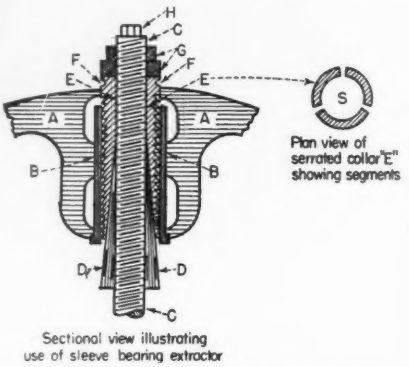


FIG. 1—Details of sleeve bearing extractor illustrating design and operation of the unit. Principal parts of device to remove bearing (B) from end-bell (A) are: Center screw (C) with threaded cone wedge (D); serrated split sleeve (E) with locknut (G). When locked in position, split sleeve teeth grip interior wall of bearing which can be driven out by pressure on head of center screw.

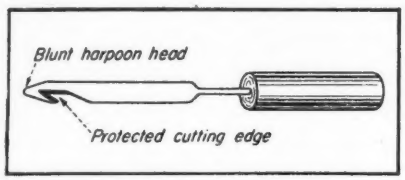
then placed over the top of the center screw from the other end of the bearing (groove "F" in this sleeve accommodates a spring coil that keeps the three segments together). Locknut "G" is then added to the assembly and tightened. Takeup on the locknut causes the split sleeve to slide over the bottom cone wedge and expand. When this occurs the teeth on the split sleeve bite into the inner wall of the bearing forming a tight-grip wedge. The bearing "B" can then be driven out of the end-bell "A" by hammering the head "H" of the center screw or, preferably by the use of an arbor press.

According to Mr. Embree, the extractor illustrated can be used on bearings ranging from ⅞-in. to 1½-in. diameters. Three extractors of different sizes will enable a shop to remove bearings from ½-in. to 2½-in. inside

diameters. The Wagner Company reports a considerable saving in labor and reduction of damaged parts when using the extractor. Total time required for one man to remove a bearing (including set-up of extractor) ranges from 5 to 15 minutes, depending on size of bearing.

Coils Protected While Cutting Slot Paper

Excess slot insulation paper can be cut away close to the windings without danger of damaging coils by using a cutting tool designed by Milton Burner, shop foreman of the Electric Service Repair Company, Paterson, New Jersey. The cutting tool has the rough appearance of a miniature harpoon but, like a carpenter's draw-knife, the cutting blade is towards the operator on the inside of the hooked head. When

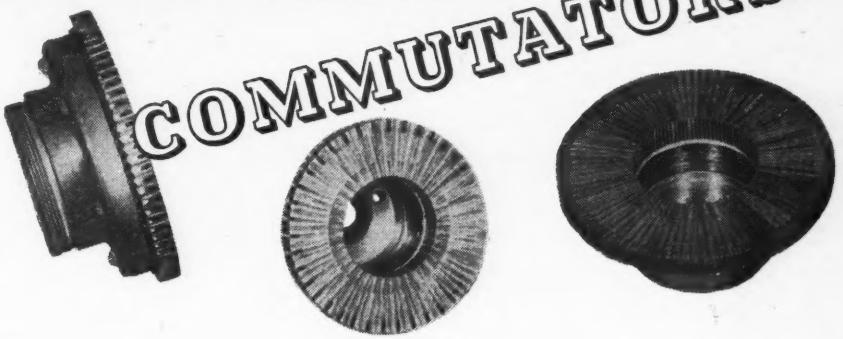


Drawing this tool along the crown of coils cuts off excess insulation paper without damaging insulation of wires. The device, operating like a button-hook, results in a neat, even, close cut.

cutting off the excess paper, the insulating paper is hooked and the tool is drawn along the coil. The angle of incidence of the tool in relation to the crown of the coil determines the closeness of cutting, the rounded point of the head automatically guarantees that the tool is kept parallel to the slots and only the paper is cut. The method prevents coil damage, results in an even, workmanlike job and speeds this operation.

Harry G. Bedig, president of the Electric Maintenance Company, Inc., Boston, Massachusetts (right), checks the progress of an unusual stator job in his shop, as a constant hp., single voltage, 4-speed motor has concentric windings re-grouped to operate at 220 rather than 440 volts.

Let's Talk About COMMUTATORS!



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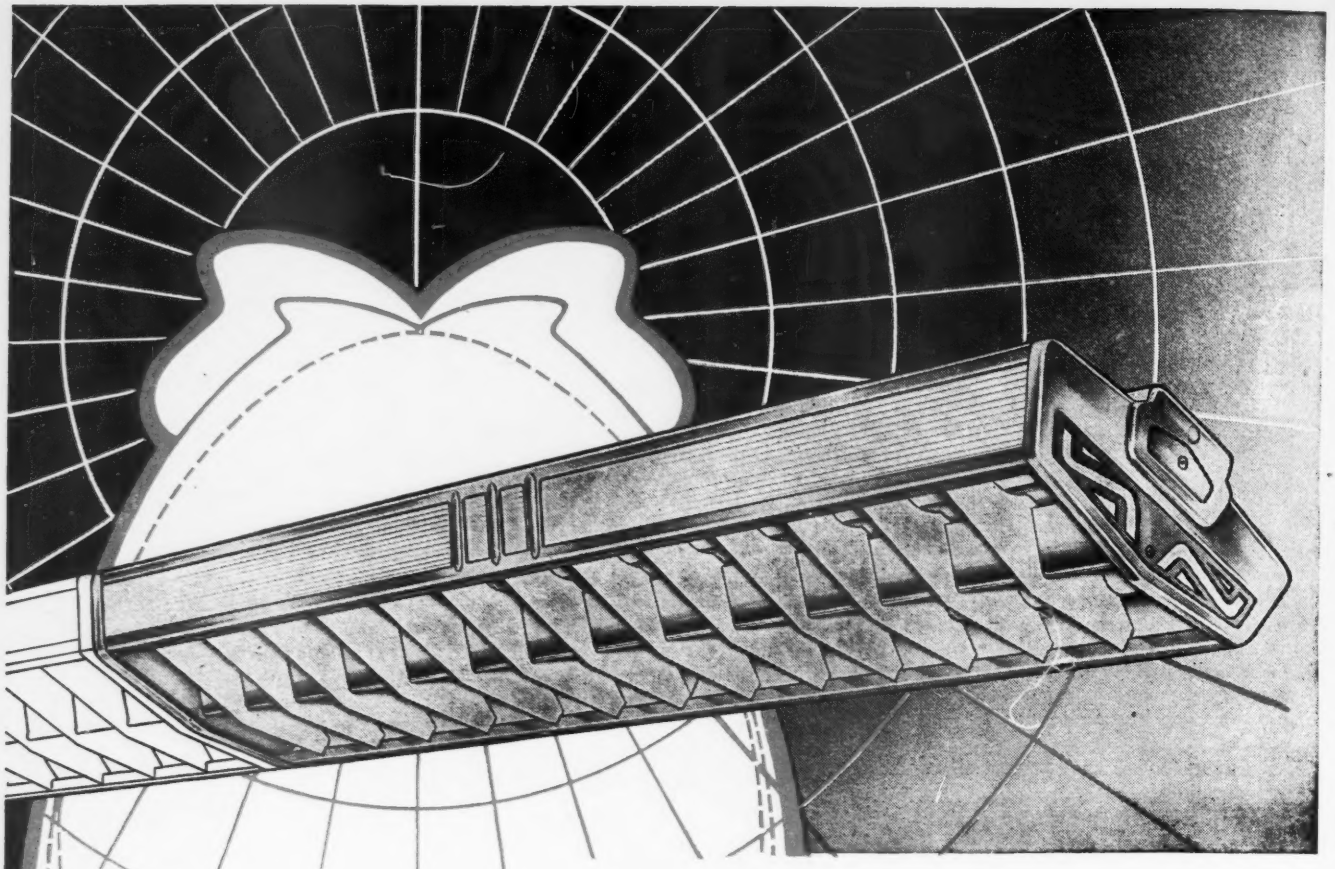

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IT'S EASY TO SEE WHEN IT'S

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Messenger Cable Supports Luminaires

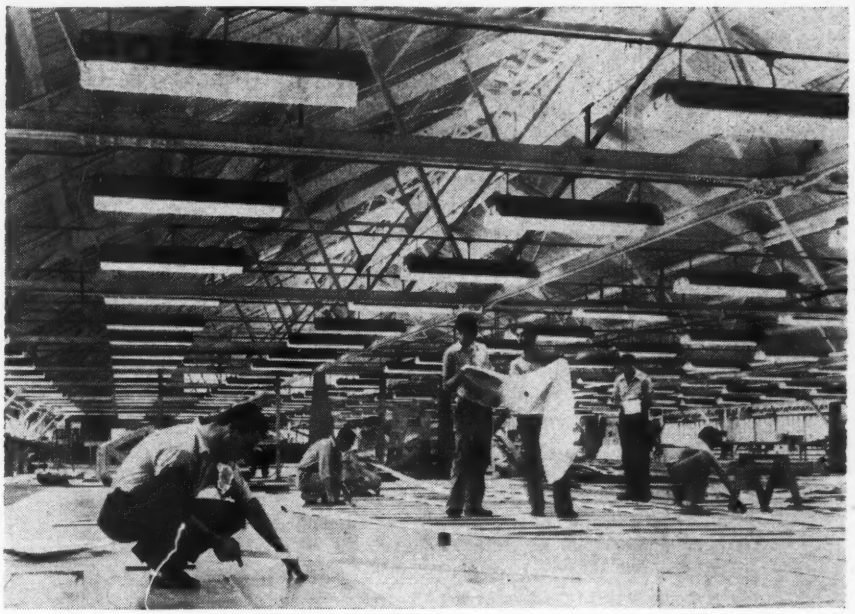
The use of messenger cable as the supporting medium for lighting reflectors proves a practical, economical expedient for suspending a uniform pattern of lighting units between roof trusses encountered in large bays with open ceiling construction. An excellent example of this mounting technique is found in the 18,000 square-foot mould loft of the Bethlehem Steel Company's Mariners Harbor shipyard, Staten Island, N. Y.

Transversely spanning the unobstructed 81 by 231-foot floor area, eleven roof trusses, 7 feet 6 inches above the loft floor, are unequally spaced at intervals varying from 16½ to 23 feet. Back-to-back angle-iron cross-members connect the third-points of the horizontal truss members.

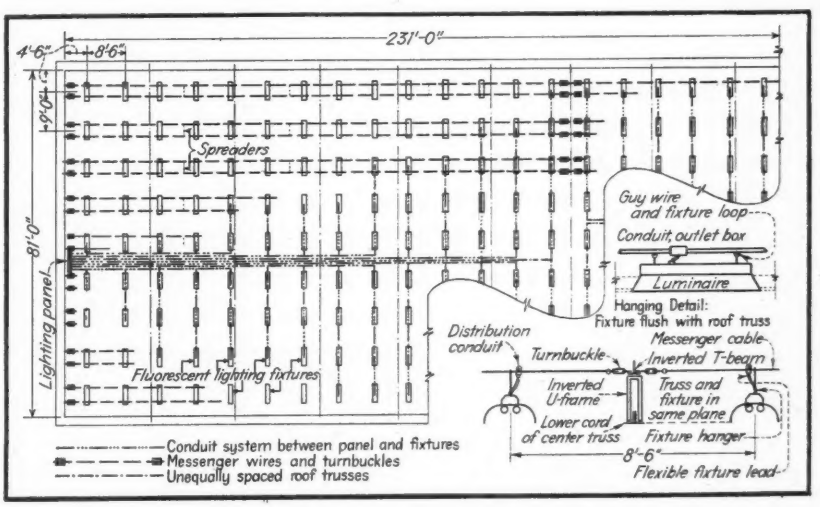
To furnish shadowless, even, medium intensity illumination to the floor surface upon which full-scale ship section patterns are scribed, the illumination plan called for a uniform pattern of industrial lighting fixtures to be suspended between these trusses with the lower limits of fixtures and trusses in the same horizontal plane. The lighting plan, as installed, contains a total of 243 fixtures, arranged in 27 rows of 9 units each, mounted parallel to the ends of the loft. Spacing is 8 feet 6 inches between rows, each row having a 9-foot center-to-center unit interval. The heavy gauge, baked white enamel, 4-foot industrial type fixtures hold two 40-watt white fluorescent lamps and operate with a .70 utilization coefficient. The resultant 1.31 watts per square foot deliver 29 footcandles of illumination to the floor level. Walls and ceiling of the mould loft are painted a flat white.

To suspend the lighting fixtures, inverted U-frames of steel were erected along the top side of the bottom chord of the center roof truss and, supported by these frames, an inverted T-beam was erected 18 inches above and parallel to the lower truss chord. Running from this T-beam towards either end of the loft, series of 6-strand steel messenger cables were stretched and tension was applied by turnbuckles located at both ends of the cables Thirty-six cables were used, 18 running through each half of the loft, grouped into 9 pairs. Each pair of cables, maintained three feet apart with spreader bars, passes over the lower chords of the trusses, supporting one luminaire from each row. Luminaires are suspended from these cables by twin steel hangers mounted on the luminaire chassis. Guy wire supports, welded to the bottom members of the intermediate trusses, consist primarily of 6-inch sleeves of ½-inch pipe.

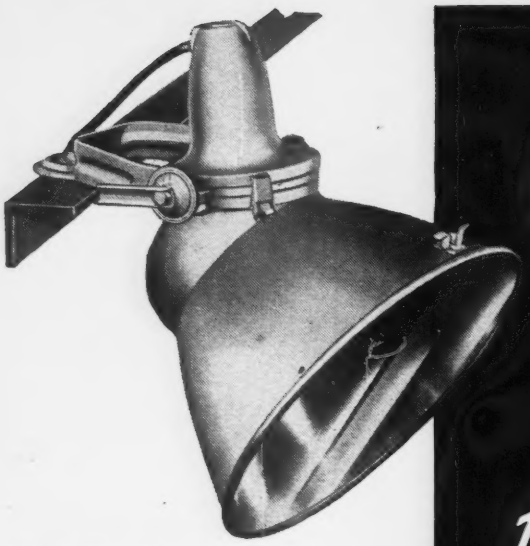
Lighting current is brought to two switch panels, one located at either end of the loft, and, from these panels, the wires are carried down the center line of the lighting system in series of ½-inch conduits. Branch conduits extend at right angles along each row of fix-



Uniform pattern of two-lamp, 40-watt fluorescent industrial fixtures are suspended from series of messenger cables which run through cable guides mounted above the lower chords of unevenly-spaced roof trusses. Messenger cables also support distribution system in conduit.



Suspended between unevenly spaced roof trusses with open ceiling construction, a uniform pattern of industrial lighting fixtures is supported by messenger cables. Distribution system runs along center of loft with branch conduits located at each fixture row. Details show hanging arrangement and construction of center-truss turnbuckle support.



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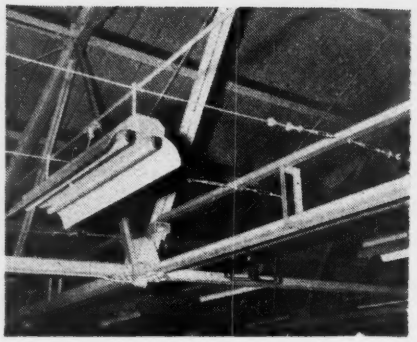
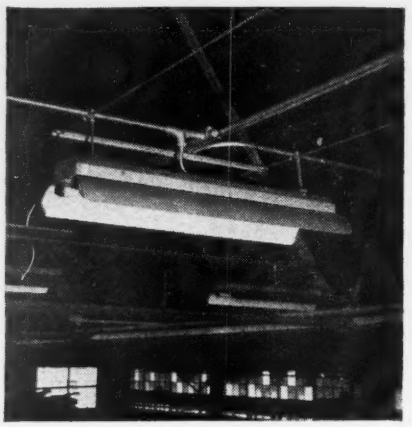


Inverted U frames, mounted at intervals along the lower chord of the center truss, support inverted T-beam to which messenger cables are attached. Cables, running from this beam to both ends of the loft, are made taut by turnbuckles.



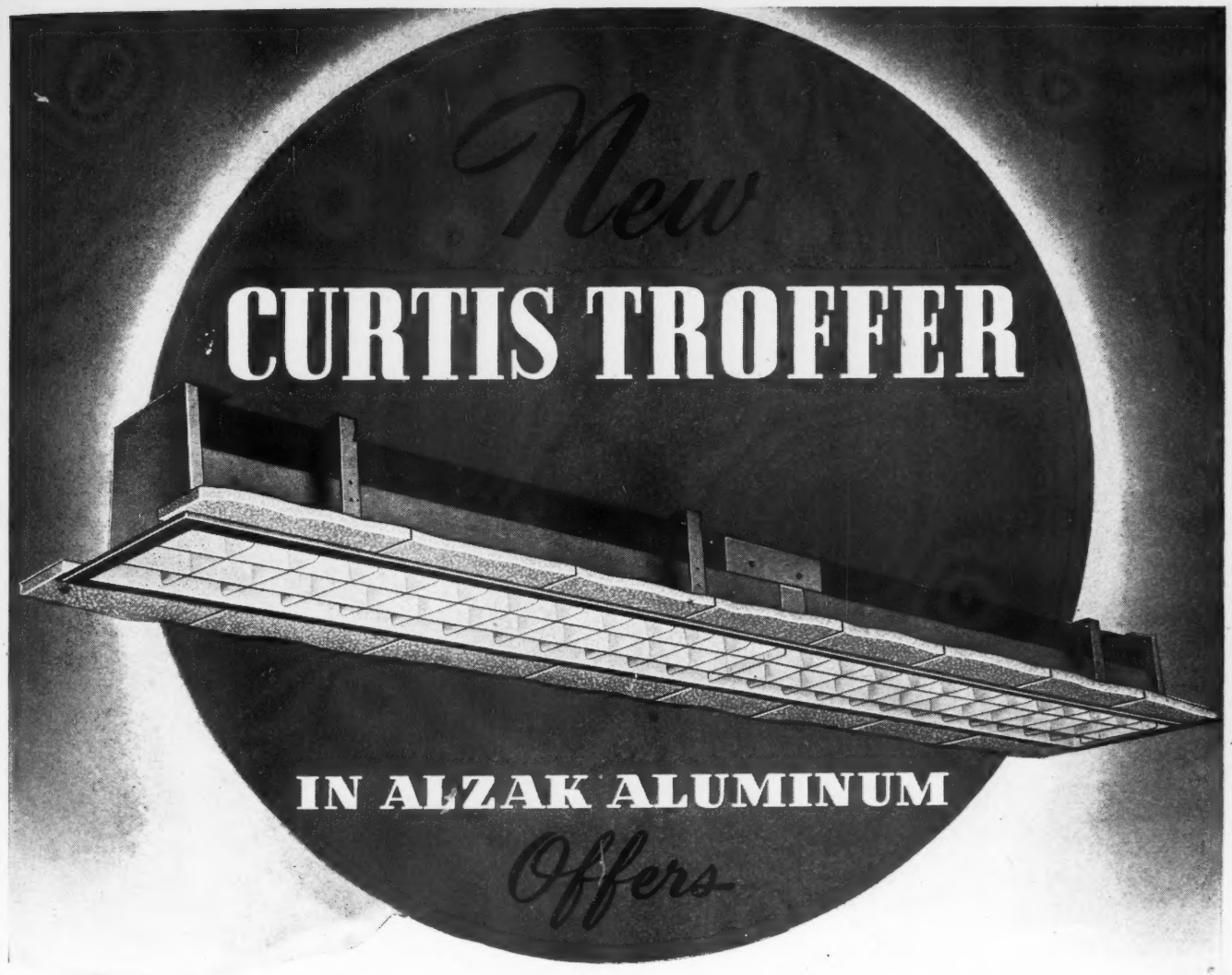
Messenger cables, each pair uniformly maintained 3 feet apart by spreader bars, support both lighting fixtures and conduit distribution system. Flexible connection carries wires to each industrial luminaire.

tures. Conduit is suspended above the lower truss members by welded angle-iron frame supports and branch runs rest directly on the taut messenger cables, held in position with heavy wire clips which bind conduit to guy wire.

Erection of the system was rapid, the appearance is trim, structural work is reduced to a minimum and material is maintained in excellent condition.

Planning a Troffer Installation

Planning a troffer lighting installation requires very thorough care and attention to details, because of the many unseen obstacles which do not appear below the level of the finished ceiling. It is important to keep in touch with the plant engineer or architect, when planning an installation of this kind, in order that all stumbling blocks can be taken into consideration before the work begins. The following suggestions, prepared by S. H. Eaton,



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Commercial Engineering Department, Sylvania Electric Products, Inc., should prove helpful in overcoming such obstacles.

In new buildings, the problem is a relatively easy one. Provision can be made in the ceiling frame-work to accommodate the fixtures, and the architect or engineer need only examine the mechanical drawings to be sure that the locations of air-conditioning ducts, sprinkler pipes and so forth, do not interfere with the lighting troffers.

There are three common types of hung ceilings. Each one presents its own particular problems. The most usual type of ceiling is perhaps the "Celotex" acoustical tile type. It is built with 2 by 4's, spaced two feet apart. The troffers are supported to these wood members. Because of their spacing, it is necessary to add another in parallel arrangement to provide one foot wide spacing.

Another type of ceiling construction is the Johns-Manville patented T-Bar type. It involves the use of longitudinal supports which are spaced one or two feet apart, and are supported by perpendicular metal straps to the ceiling. There are no cross members and installation of troffers is quite easy.

A lath-and-plaster ceiling presents the greatest problem in installing troffer equipment. Here, 2 by 4's are usually used running in one direction with wood or metal lath nailed to them. After the lath-and-plaster is cut away, it is not only necessary to obtain proper spacing of the 2 by 4's to support the troffer, but a metal plaster frame must also be constructed within the opening in the ceiling so that the plaster can be patched and finished against the frame before the troffer is secured in place. Because of variations in ceiling construction, plaster frames are usually made up on the job. They frequently consist of a one-inch angle iron which acts as a rim to the ceiling opening.

Following are some of the things to watch for when planning a troffer lighting installation. Consideration of these factors before the job begins, while in the planning stage, will do much to eliminate the major headaches associated with the installation of troffer lighting systems.

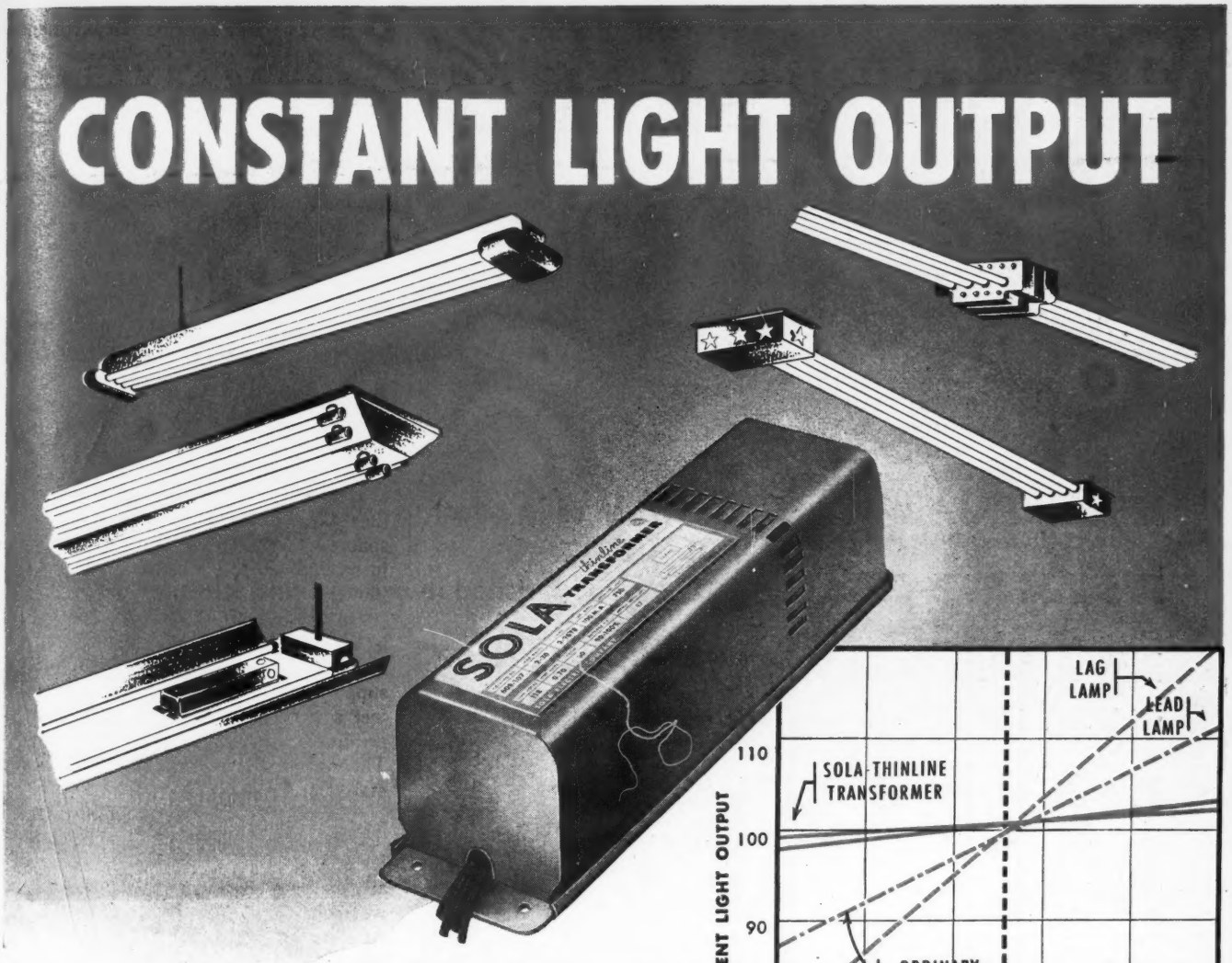
1. Check the spacing between hung ceiling and main ceiling to be sure that there is ample room to recess the troffer.

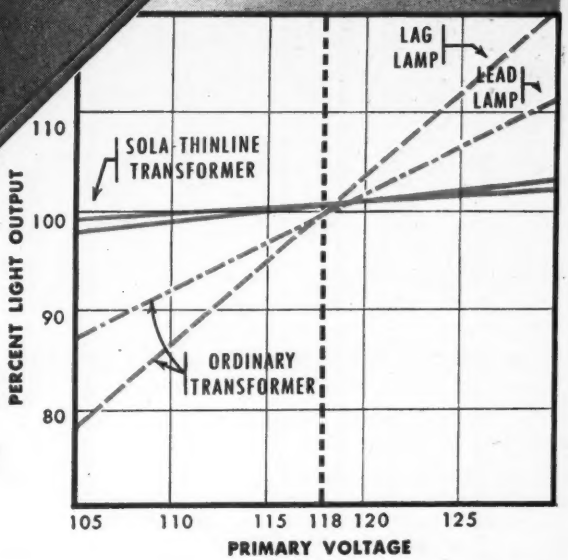
2. Check the type of ceiling construction and note the direction in which the main supporting members run.

3. Be sure that the vertical supports from the main ceiling to the hung ceiling are numerous enough to support the added weight of the troffers.

4. Be sure that the main horizontal supporting members are spaced one foot

CONSTANT LIGHT OUTPUT





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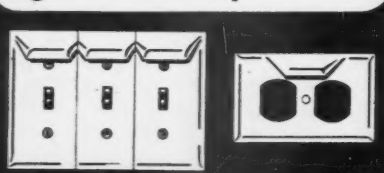


For all single and multi-gang toggle switch panels. Matching units for convenience outlets

—LumiNite lights automatically when you turn room lights off!
—Goes out when room lights are turned on!
—Ends fumbling for switches in the dark!
—Its "safety" glow helps prevent accidents!
—Keeps wall free of smudges from groping hands!
—Shows when you've forgotten to turn off lights remote from switch!
—Operates for less than 2c per year!
—Lasts for years without a burnout!
—Operates on 2, 3 and 4-way switches!
—Listed by Underwriters' Laboratories!
—Adds extra profits to every wiring job! Write for LumiNite details or see your jobber today!

ASSOCIATED PROJECTS CO.
80 E. Long St. • Columbus 15, Ohio
In Canada: LumiNite Products Co., Ltd.
2271 Danforth Ave., Toronto, Ontario, Canada

apart at the location where the troffer is to be installed.

5. Check the location of sprinkler pipes, ventilating ducts, steam pipes and all other possible obstructions above the suspended ceiling.

6. Check the location of any structural steel which would limit the required depth of space for the troffer housings above the suspended ceiling.

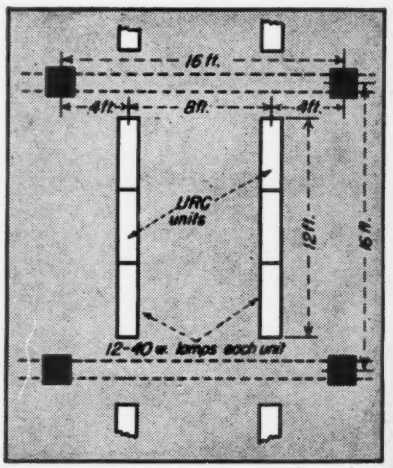
7. Give full cooperation to the architect or structural engineer, furnishing full and complete information, dimensions, etc., on the troffer equipment, so that they may make the necessary changes required to assure that the troffer equipment may be installed properly.

Daylight Quality Office Lighting

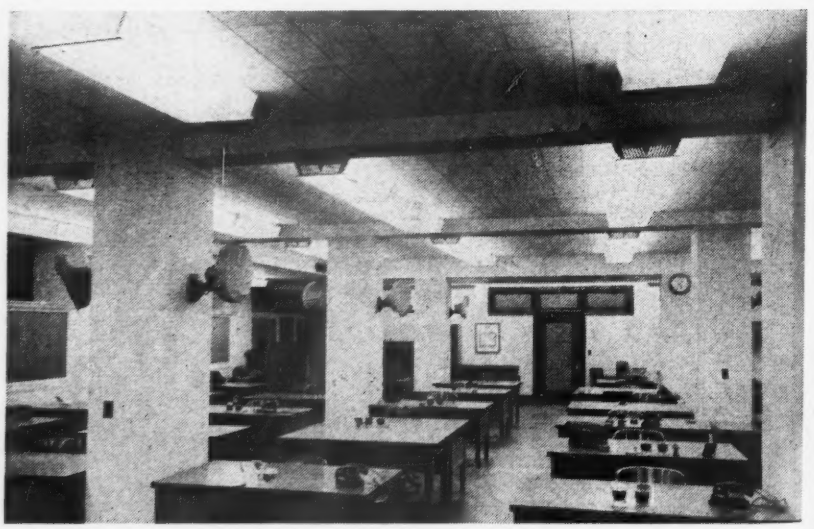
A total of 144 URC type Solarlites were used to relight the Seventh floor of the Lexington Building, Baltimore, Md. Occupied by the Accounting Department, Consolidated Gas Electric Light and Power Company, this area is lighted to a high intensity of well diffused daylight quality illumination.

Columns located throughout the area divide the space into 16 ft. by 16 ft. bays. The ceiling height is 10 ft. 6 in. The ceiling is acoustical tile, with reflection factor of approximately 75 percent, while side walls have a reflection of approximately 55 percent. Beams 10 inches deep run from column to column across the width of the room.

Two 3-gang, 12-foot long, URC units of the ceiling mounting type were used in each bay, running normal to the beams. Each 3-gang unit contains 12 40-watt daylight lamps. The bottom of these units, located on eight-foot centers between rows, is approximately 7 ft. 2 inches above the desk tops. Spacing between rows is therefore approximately equal to the mounting height above the desk tops, and a remarkably uniform intensity of light is provided throughout the area. This installation, planned by Clarence J. Berry, Illuminating Engineer for the Consolidated Gas Electric Light and Power Company of Baltimore, was designed for a maintained intensity of 50 footcandles, using daylight fluorescent lamps. Initial readings were above 90 footcandles average. Use of the daylight lamps has the effect of creating a cool, pleasant atmosphere and of enabling workers to see easily with apparent less eye fatigue.



Typical lighting layout in 16-foot square bay. Layout provides one 40 watt daylight lamp for each 21 square feet of floor space.



Daylight fluorescent lamps in URC units provide an initial intensity of 90 footcandles of cool, comfortable lighting in the Accounting Department of the Consolidated Gas Electric Light and Power Company of Baltimore, Maryland.

"Certified" ON A BALLAST...
IS MORE THAN A WORD!
. . . Measuring Certified Ballast temperatures while ballast is operating in an actual fluorescent fixture.
Hot Box! Certified Ballasts are tested and checked against *overheating*. Test oven determines temperature rise.
Certified Ballasts are checked and rechecked in actual service—an additional safeguard for high quality.

When fluorescent lighting fixtures are equipped with Certified Ballasts, you and your customers are protected

YES, "CERTIFIED" on a ballast means that this ballast has been built to exacting specifications set up by lighting experts . . . that it has been *tested, checked* and *CERTIFIED* by impartial Electrical Testing Laboratories, Inc.

"Certified" further means ballasts that are *quiet* in operation . . . protected against overheating . . . and long lived. And they cost no more than any other ballasts!

Write today for new booklet, "The Story of Certified Ballasts".

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Makers of Certified Ballasts for Fluorescent Lighting Fixtures

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Essex Wire Corporation
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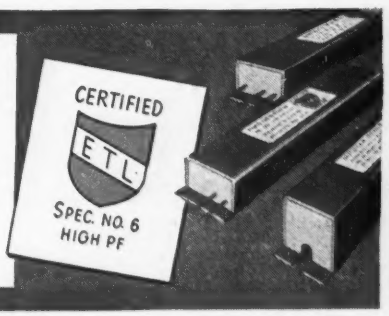
General Electric Co.
Specialty Transformer Division
Fort Wayne, Ind.

Jefferson Electric Co.
Bellwood, Illinois

Sola Electric Co.
2525 Clybourn Avenue
Chicago 14, Illinois

Starring and Company
Bridgeport, Conn.

Wheeler Insulated Wire Co., 378 Washington Ave., Bridgeport, Conn.



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DISTRIBUTOR

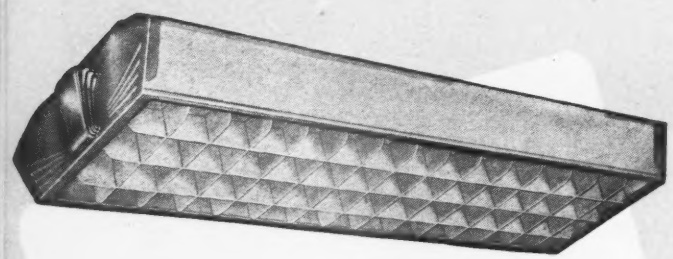
I PREFER MITCHELL Commercial Lighting because it's easier to sell. Both contractors and users recognize and *demand* MITCHELL quality and appearance. Customer satisfaction is assured, and my reputation is protected. That's why *my* Lighting Department concentrates on MITCHELL, the complete line that fills every commercial need.

CONTRACTOR

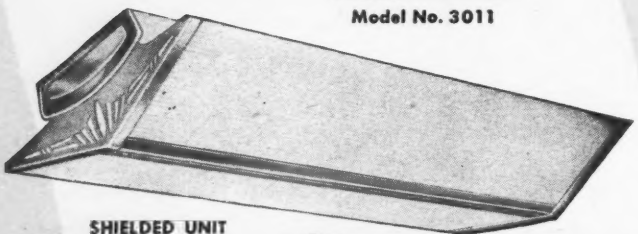
I PREFER MITCHELL Commercial Luminaires because they're easier to install and maintain—accepted absolutely by my customers as top-quality lighting units. I've had plenty of experience with commercial lighting installations, and *I'll* stay with MITCHELL, the line that builds acceptance for my skill and service.

USER

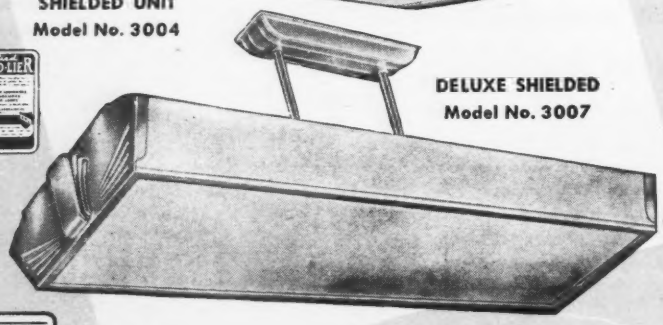
I PREFER MITCHELL Lighting because I know I'm getting carefully planned quality illumination to fit my needs. I like the combination of functional efficiency and modern beauty of design. MITCHELL Commercial Luminaires are a genuine asset to my business. *I play safe —I* buy from the house that sells MITCHELL.



DELUXE LOUVERED
Model No. 3011



SHIELDED UNIT
Model No. 3004



DELUXE SHIELDED
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MODERN BEAUTY IN EACH DESIGN
COMPLETE LINE TO FILL EVERY NEED
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Answered by
F. N. M. SQUIRES and GLENN ROWELL
New York Board of Fire Underwriters
Chief Inspector
New York, N. Y.
Electrical Engineer
Fire Underwriters Inspection Bureau
Minneapolis, Minn.

Questions on the Code

Neutral Grounds

Q. *A new contractor in our town insists on using a perforated copper strap for his neutral grounds. I have always been of the opinion that the strap alone was not accepted by the Code as suitable for a neutral ground clamp. Will the Code ruling justify my issuing a rejection slip on a job grounded in this manner?*—J.J.N.

A. The use of a strap of the sheet metal type fastened together by a stove bolt is not considered suitable for a neutral ground clamp due to the fact that it is difficult to maintain good electrical conductivity between such a strap and a water pipe or grounding electrode. Sections 2614 and 2615 of the Code cover this question. The accepted means include, first, the bolted clamp of cast bronze, brass or of plain or malleable cast iron; second, a pipe fitting or plug screwed into the pipe or pipe fitting; and, third, the solid metal base or shoe held against the pipe or electrode by a suitable strap that is not liable to stretch during or after installation. The perforated sheet metal strap is considered suitable only as an equipment ground. —G.R.

Connections at Service Equipment

Q. *The service consists of electric metallic tubing connected to the main switch with a connector, locknut on the inside—the knockout being concentric type. Does this satisfy rule 2572 or must a ground bushing and jumpers be provided?*—E.S.

A. Where concentric or eccentric knockouts are used in the service equipment box, the service conduit, whether rigid conduit or electric metallic tubing, must have bonding bushings on the coupling between the raceway and the box in order to satisfy 2572c (now 2572c in Interim Amendment No. 55).—F.N.M.S.

Rewiring an Office

Q. *We are rewiring a fair size office in a large fireproof building which will necessitate the installation of additional feeder capacity. If this feeder run is placed within an existing ventilating duct, we can save both conduit and copper as it is quite some distance from the pipe ways in this building to the new distribution location in this office. Will the Code permit a conduit run within this duct?* —E. P.

A. The answer to your question is not found in the 1940 edition of the N. E. Code but will be found under Section 3020 of the 1947 edition. This is a new section and gives permission to place an electrical circuit within a ventilating duct provided the methods used comply with the requirements of this section. Inasmuch as copies of the new code are not generally available as yet, the complete text of this section is as follows: "Electrical installations shall be so made that the possible spread of fire through fire-stop partitions, hollow spaces, fire walls or fire partitions, vertical shafts, ventilating or air conditioning ducts is reduced to a minimum. No wiring system of any type shall be installed in ducts for dust, loose stock or vapor removal. Where it is necessary to run a wiring system through air conditioning ducts or plenum chambers, the wiring method shall be rigid conduit, flexible steel conduit with lead covered conductors, or type ACL armored cable, with fittings suitable for the location. The terminals of circuits of such wiring systems shall be so located that it will not be necessary to install motors or control equipment in the ducts except for temperature and humidity control. Raceways shall not interfere with the operation of automatic fire dampers in the ducts." Following this section a note contains this warning: "Consideration should be given to expansion and contraction of runs of conduit from temperature changes."—G.R.

Polorization

Q. *Is there a special plug receptacle combination prong arrangement required for 220 volt single phase connections on a standard 110-220 volt single phase system? If not, I'd assume that it is considered to be good practice to have 220 volt receptacles able to receive a standard 110 volt cap but am not aware of a tentative standard for such a receptacle.*—M.M.P.

A. The answer seems to be quite clearly stated in Paragraph c of Section 2111 of the Code as follows:

"2111 Receptacles. c. Interchangeability. Receptacles supplied by circuits of more than 150 volts between conductors shall be of such design that attachment plugs used on circuits of other voltages cannot be inserted in them."

This indicates that there should be a design for receptacles and their attachment plugs for 125 volts which will not be interchangeable for those rated at 250 volts or other voltages. This would mean that the 125 volt plugs would not fit into the 250 volt receptacles.

Then there would have to be different designs for other voltages such as 440, 600 etc. and also other designs for 3 wire, 125-250 volts, 3 phase 250 volts, 440 volts, etc. etc.

Undoubtedly that is what *should* be done and what the Code requires and what *must* be done for safety's sake.

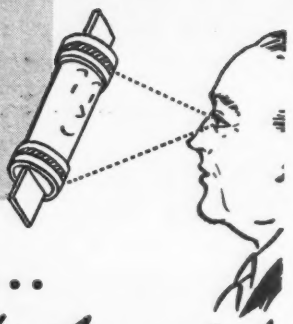
What *is* being done however, at the present time, is somewhat different apparently. There are devices listed now with classifications of both 125 and 250 volts. Surely such devices do not seem to meet the letter of the Code.

Evidently the ruling is being interpreted to mean that there shall be different designs of plugs and receptacles so that a user may choose from these various designs and select one for 125 volts, another for 250 volts and so on.

If this latter is the intent of the Code, the wording of the Code should be changed so as to unquestionably state what it does mean.—F.N.M.S.

WHEN YOU MEET A

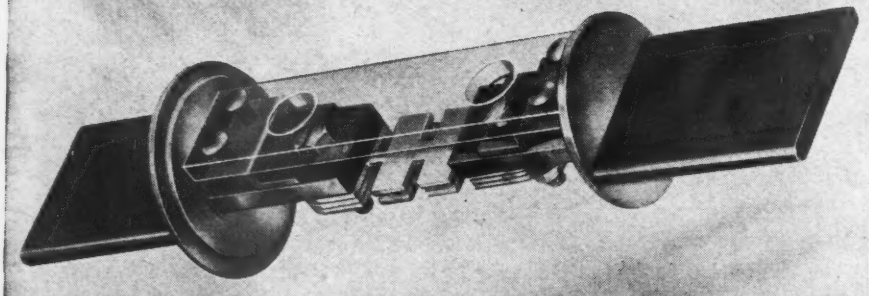
Monarch Fuse



FACE TO FACE....

You are Impressed with the Amount of

BRASS



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AS WELL AS...

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Thin Wall Conduit

Q. *We are planning to submit a bid on a new milk processing plant on which the specifications call for the use of thin wall conduit. Will there be any special changes in the new Code pertaining to the use of this material.*—M.L.

A. Yes, the next edition of the N. E. Code will contain two changes which will affect an installation such as you are interested in. Section 3482 will prohibit the use of electrical metallic tubing protected from corrosion by enamel only and Section 3484 will require that the tubing be supported so there is a ½ inch clear space between tubing and building surface in wet locations, such as are commonly found in dairies, laundries and canneries. Incidentally, this clearance requirement will also apply to rigid conduit installations in wet locations.—G.R.

Aluminum Wire

Q. *I plan on wiring a number of small houses and the only kind of wire I can get is aluminum. What size must I use on the appliance circuit?*—J.T.

A. At present there does not seem to be an answer for your problem except that an attempt should be made to get enough No. 12 copper for these circuits. No. 10 aluminum would have the carrying capacity necessary for these circuits, but there is some question as to whether or not No. 10 could be fastened to the average screw terminal on wiring devices. —G.R.

Time Lag Fuses in Motor Controller

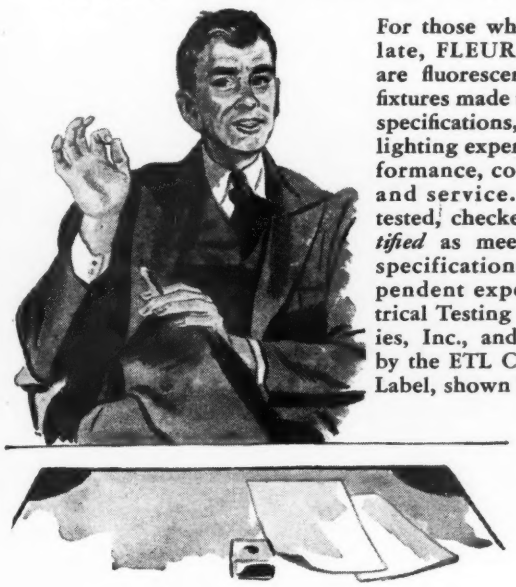
Q. *I have a 40 hp. 440 volt a-c with rotor motor 51 amp. full load. I have a 200 amp. three pole fused switch in order to obtain a 50 hp. rated switch for ordinary fuses. I need 51 x 150 = 76.5 amp. or 80 amp. fuses. For super lag fuses I need 51 x 125 = 63.75 amp., or 65 amp. fuse. I would like to know how I can put a 65 amp. or 80 amp. fuse in this switch unless I use a fuse reducer?*—G.K.

A. A motor controller must have a horsepower rating equal to that of the motor which it controls.

The Case of the INQUIRING LIGHTING SALES MANAGER

Chapter Three: HE LEARNS ABOUT FLEUR-O-LIER ADVANTAGES

FLEUR-O-LIER? You said they are . . .



For those who tuned in late, FLEUR-O-LIERS are fluorescent lighting fixtures made to exacting specifications, set up by lighting experts, for performance, construction and service. They are tested, checked and *certified* as meeting those specifications by independent experts, Electrical Testing Laboratories, Inc., and identified by the ETL Certification Label, shown below.

What important *features* do FLEUR-O-LIER specifications cover?

We're glad you asked. They cover electrical and mechanical safety, durability, *Certified* high power factor ballasts, *Certified* starters, efficient lighting performance, ease of maintenance and many others.

Are all these manufacturing standards rigidly maintained?

You bet! Besides the testing done at Electrical Testing Laboratories, Inc., E.T.L. inspectors periodically check samples at the individual factories of FLEUR-O-LIER Manufacturers. That gives you a double check on *uniform high quality* fixtures.

This Label is your clue to good lighting fixtures!

It is your definite assurance of *electrical, mechanical and lighting excellence* in fluorescent lighting fixtures!

FLEUR·O·LIER *Manufacturers*

Fleur-O-Lier is not the name of an individual manufacturer, but of a group of 27 leading fixture manufacturers. Participation in the FLEUR-O-LIER MANUFACTURERS' program is open to any manufacturer who complies with FLEUR-O-LIER requirements.

"I know they're good... they're KLEINS

"IF you've ever worked on a pole 50 feet in the air with the wind whistling around your ears, you know why linemen need good tools. That's why there'll always be a pair of Kleins in my tool belt. I know they're good."

Yes, to the men who install and maintain the nation's power and communication lines there is only one kind of pliers . . . Kleins. There's a sound reason for this overwhelming preference. For linemen and electricians—men who know good tools—also know of the quality materials and handcraftsmanship that go into every pair of Kleins. To them this excellence means speed, efficiency and safety on every job.

The complete line of Klein Pliers is in full production but demand still exceeds supply. Your supplier will fill your order as soon as possible.

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A copy of the Klein Pocket Tool Guide, showing the Klein line and containing valuable tool information, will be sent on request.

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The code provides that where conditions of maintenance and supervision provide that a supply of appropriate fuses will be continually available, fuse holders of less capacity than otherwise necessary, may be used. These "appropriate fuses" are of the time-lag type. This has allowed switch manufacturers to make up fused switches with proper horsepower ratings, but with fuse holders of ratings to take fuses of 125 percent of the motor ratings. Such fuses are so marked by the manufacturer.

Of course it must be remembered that where competent supervision and maintenance are not provided and where a sufficient extra supply of time lag fuses is not kept on hand, this provision for smaller fuse holders does not apply.—F.N.M.S.

Connectors for Farm Wiring

Q. *What can we use on farm jobs on the R.E.A. lines as a substitute for Romex connectors?*—A.H.B.

A. The shortage of connectors suitable for use with nonmetallic sheathed cable has become serious. This probably can best be handled sparately by states or even by the individual R.E.A. projects as it is only a temporary condition. In one state the contractors have been given permission to use porcelain or phenolic resin bushings in the knockouts of steel boxes if they are unable to purchase an adequate number of nonmetallic boxes. They are, of course, required to support the cable within six inches of the box if bushings are used instead of the approved connectors.—G.R.

Conductors In A Pull Box

Q. *There is some confusion in my mind as to when conductors within a pull box must be racked or cabled. No two inspectors seem to agree on this question, and on large jobs the man hours required to cable or rack the conductors is bound to be rejected in the estimated cost. Is there some ruling in the Code in addition to Section 3706-b that covers this?*—W.L.

A. The only other section in the 1940 Code which might be considered as prohibiting the "bird

nests" so often found in the larger pull boxes is contained in Section 1105 which covers the mechanical execution of all work. The 1947 edition of the Code under Section 3708-b will definitely answer your question as this section is worded as follows:

"In pull boxes or junction boxes having any dimension over six feet, all conductors shall be cabled or racked up in an approved manner."

While this is definite, it will not be of too much assistance as the percentage of boxes having one dimension greater than six feet is small and I personally believe an electrical inspector is justified in requiring that the conductors be racked or cabled whenever he finds a box of the "bird nest" variety and he may justify such action by referring to Section 1105.—G.R.

Protection of Service Cables

Q. *I have installed service cables on some houses and have been advised by our inspector that they must be enclosed in conduit within 8 feet of the ground. Is this correct?*—C.K.

A. Section 2332 of the Code governs some of the uses of service entrance cables on buildings.

It states the service entrance cables if liable to contact with awnings, shutters, swinging signs, installed in exposed places in driveways, near coal chutes or otherwise exposed to mechanical injury, shall be of the protected type or be protected by conduit, tubing or other approved means.

The unprotected type of service entrance cable is listed as Type SE Cable and the protected type is listed as Type ASE and Type ASE*. (The Type ASE* may be used for either above ground or underground).

The Type ASE and Type ASE* are therefore approved for use where exposed to mechanical injury.

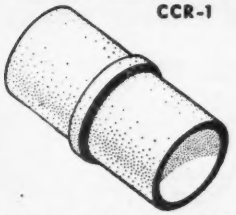
The Type SE Cable could be used without protection where not subject to mechanical injury, as for instance on the lawn side of a house, but would have to be protected by conduit or raceway on the driveway side.

All types of service entrance cable (but not service drop cables), have labels attached every 20 feet giving the type designation etc.

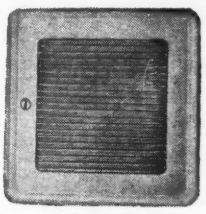
It is interesting to note that Type USE (underground) cable, is required to be protected from the direct rays of the sun by means of conduit or other raceway where installed above ground. This is not required for the Types ASE or ASE*.—F.N.M.S.

ELECTRICAL SPECIALTY ITEMS FOR THE CONTRACTOR

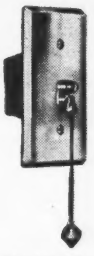
CONDUIT COUPLING TYPE CCR-1



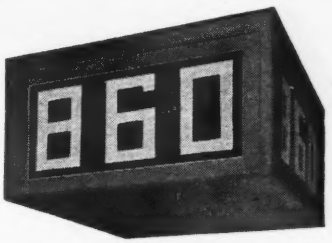
A Thin Wall ½" E.M.T., zinc, indenter tool type. Overall length 2". Standard package 500 pieces; carton 100 pcs. Approx. 1800 pcs. per 100 lbs.



AISLE LIGHT

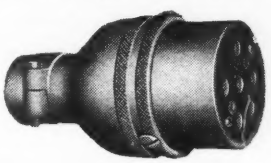


CALLING STATION

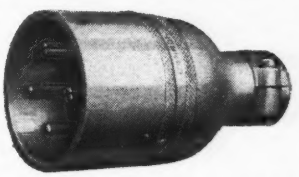


SILENT VISUAL PAGING

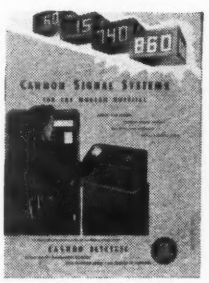
Used extensively by contractors for hospitals, public buildings and factories, Cannon Signal Systems include Silent Visual Paging Systems, Bedside Calling Stations, In-and-out Registers, Aisle, Corridor and Intersection Lights, Explosionproof Switches for Nurse's Call, Visual Station Annunciators, Supervisory Station Annunciators, Supervisory Stations, Electrostatic Grounding Intercouplers, "Knight" Lights. Other specialties include Program Bell Transfer Panels, Footrail Alarm Switches, Push Buttons, Fire Alarm Boxes. Write for the catalogs indicated below.



Type "M" POWER PLUGS 440 Volt



For heavy-duty power circuits, Type M1-4 series is listed as approved by Underwriters' Laboratories. M1-4 carries four 30-amp. contacts and is available in straight cord, angle 90° and several wall receptacle types. M2-A4 and -B4 carry 30- and 60-amp. contacts respectively. Write for Type "M" Bulletin.



Cannon Signal Systems Catalog covers the signal line of equipment and includes Architect's Typical Specifications and comparative catalog numbers. Write Dept. L-231 for a copy.

FOR LOW LEVEL SOUND CIRCUITS

XL-3-11 Cord Plug $1.25 List

XL-3-12 Cord Plug $1.20 List

XL-3-14 Recep. $1.00 List

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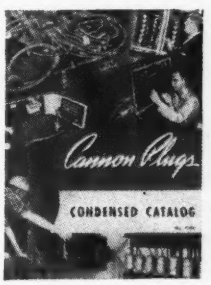

The C-46-A Condensed Catalog contains the majority of prices and fittings and equipment manufactured by Cannon Electric. Write Dept. L-231 for a copy.

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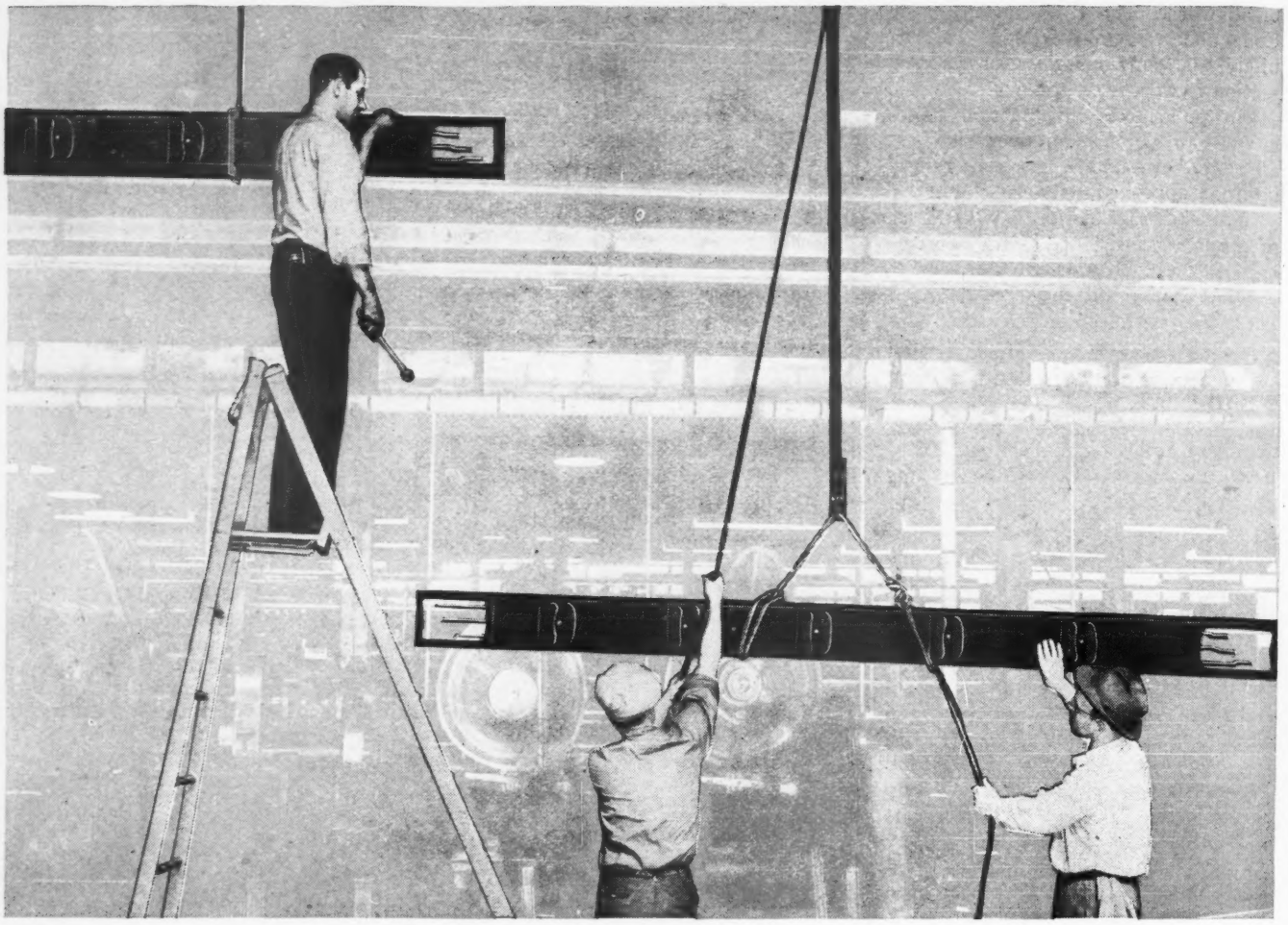

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In the News

Western Inspectors Meet in Cincinnati

Thorough discussion of changes appearing in the new National Electrical Code highlighted the 42nd Annual Convention of the Western Section, IAEI, on Oct. 21-23 at Hotel Gibson, Cincinnati, Ohio. Registration exceeded 500.

Justification of conferences of this type was set forth by B. C. Hill, Oakland, Calif., in his address as International President, IAEI. This is one meeting where all electrical industry representatives can assemble and exchange information on latest developments in their respective fields. In addition, it offers the electrical inspector an unparalleled opportunity to keep abreast of progress, Hill asserted. With a membership of about 6,000 (more than 1,000 added this year), this group is in an excellent position, through its daily field contacts, to report safety deficiencies or defects in electrical installations and equipment. Evidence of its effectiveness is the contribution made to the Electrical Committee in improvement of code regulations; Mr. Hill added, urging a larger active membership; restoration of pre-war standards of electrical safety; financial independence of the organization; and just recognition and compensation of the electrical inspector.

Progress along the legislative front was reported by V. C. Moulton, Denver, chairman of the Legislative committee. A model inspection ordinance is now ready for IAEI approval and will probably be ready for application in 1947 and 1948. Once approved, the committee will start on the development of state licensing and sales control laws, he stated.

A major portion of each session was devoted to a discussion of the various code articles with specific emphasis on the changes in the new 1947 Code. Such experts as O. K. Coleman, Lafayette, Indiana; L. P. Dendel, Lansing, Michigan; C. M. Park, Chicago; L. W. McCullough, New York City; and C. F. Hedland, Boston, led the discussion.

Again the problem of electrical inspector's responsibility in determining degree of hazard came up during a discussion of Article 500. It was suggested that inspectors learn to use flammable gas indicators and similar instruments to make such determinations. General opinion, however, was that fire departments or fire prevention bureaus that have the proper equipment—should make this survey. Electrical inspectors would then make their recommendations on the basis of the results.

Although the Canadian Electrical Code is quite similar to our National Electrical Code, it apparently is much more strict with respect to personal accident hazards. In comparing the two codes, E. W. McLeod, assistant chief electrical inspector, The Hydro-Electric Power Commission of Ontario, noted more pertinent differences: The Canadian Code prohibits convenience outlets in bathrooms; requires vulcanized rubber insulation on individual conductors of flexibile heater cords; requires automatic establishment of a ground connection through a polarized grounded attachment plug on portable electric drills, grinders and similar devices likely to be used in damp locations. Such domestic devices as hair dryers, washing machines, etc., must have a grounding connection; frames of motors must be insulated from frames of machines and motors must be guarded by skirting of machines; electric razors must withstand a 2500 volt dielectric test. To aid inspectors, all requirements for various divisions of hazardous location classes are listed separately under the respective heads in the Canadian Code, McLeod revealed.

The recently settled trucker's strike in New York City delayed publication of the revised National Electrical Code to such an extent that it will not be available until about the end of this year, V. H. Tousley reported. Hence, it will be known as the *1947 Code*. Interim amendments to the 1940 Code will remain in effect until the 1947 Code is distributed, Tousley advised.

Combined as a conference paper and Article discussion was the illustrated talk of Robert Luscombe, sales manager, Penn Electric Switch Company, which outlined the application of the new Article 725 to control of automatic heating systems. Specific emphasis was placed on the two classes of wiring-Class 1 (safety controls on circuits without power limitation) which must be in conduit; and Class 2 (low-energy circuits in which power is limited)

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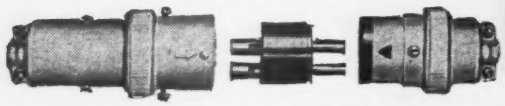

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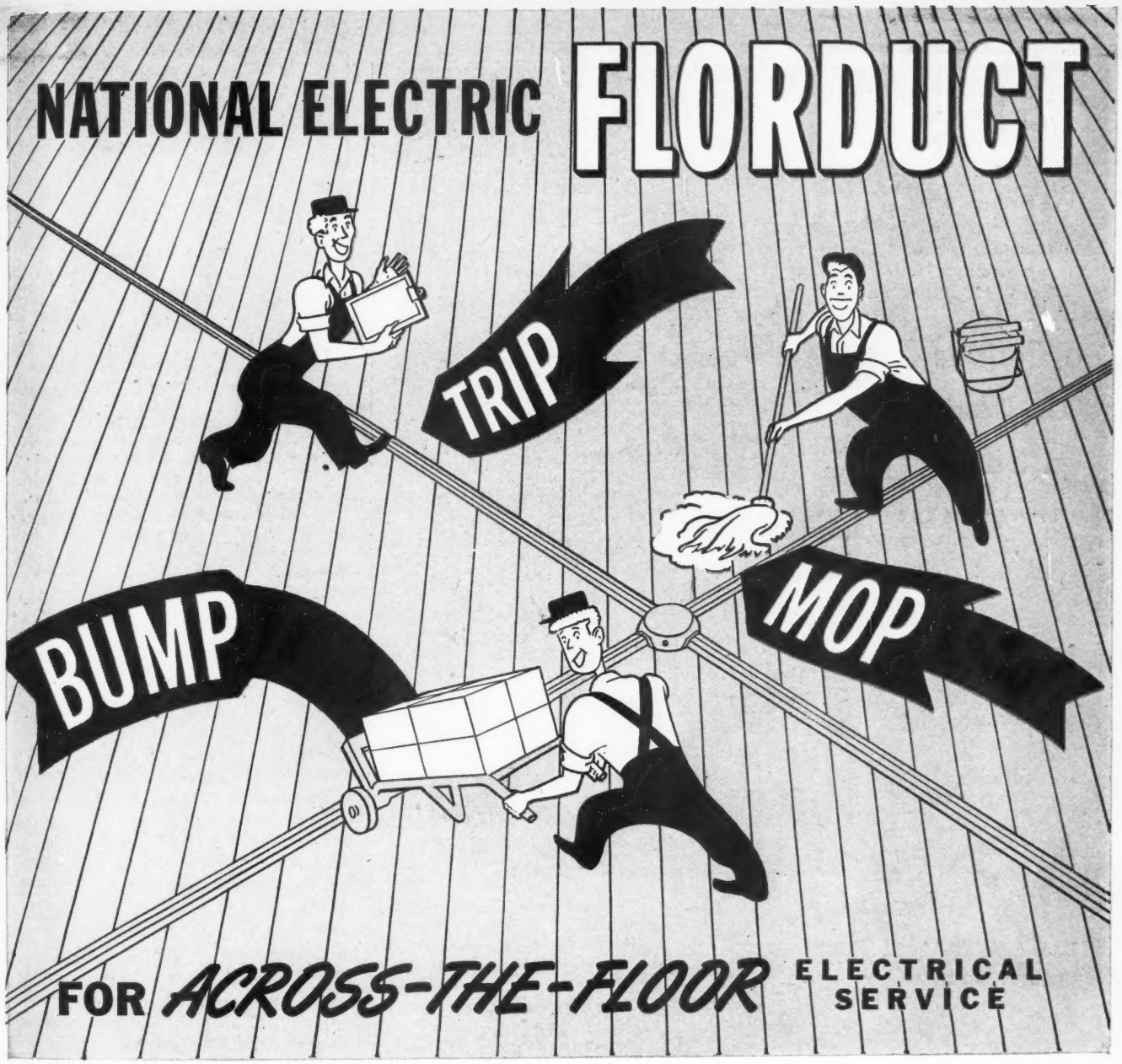
which need not be metallically encased. Line voltage primary control circuits and thermostats are in the first category; low-voltage room thermostats, service hot water temperature regulating devices and similar controls fall in the second category, Luscombe revealed.

Marked economy in industrial primary network systems is effected by the 1947 Code which permits installation of primary feeders up to 15,000 volts in conduit without an envelope of concrete, brick or equivalent fire-resistant material, also location of secondary substations at or near load centers, asserted John S. Parsons, Westinghouse Electric Corp., East Pittsburgh. Exception was taken to section 4512-b (overcurrent protection) which, in his opinion, apparently is unnecessarily restrictive and imposes an economic burden on both network and radial systems. Mr. Parsons feels that the requirement of primary overcurrent devices in the primary leads of all transformers in a majority of network systems cannot be justified, in many cases, by either engineering or safety reasons. Delving into overcurrent and short circuit protection methods in minute detail, Parsons suggested code changes that would remove the contended economic burden and still retain full safety. He also suggested that transformer name-plates, at least for ratings of 100 kva. or more, indicate the percent impedance of the unit, since it is necessary to know this value if compliance with section 4512-b is to be ascertained.

With a short supply of practically every material going into insulated wire production, the outlook for the future is not too bright, stated G. E. Rolston, vice-president and sales manager, Rome Cable Company. Recent de-

New president, Western Section, IAEI, A. H. Welklin (right), Ft. Wayne, Indiana, receives best wishes from immediate past-president George C. Monroe, Springfield, Missouri.

NATIONAL ELECTRIC FLORDUCT



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Ten No. 14 insulated wires,
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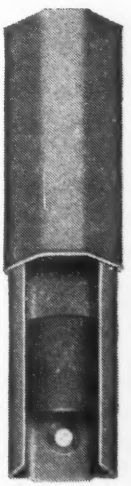

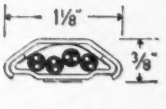

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TRENTON, NEW JERSEY

V. C. Moulton, electrical engineer, Mountain States Inspection Bureau, Denver; and L. D. Price (right), NEMA, New York, discuss electrical inspection, licensing and sales control legislation during Western Section, IAEI Conference in Cincinnati.

velopments in wire production: Nonmetallic sheathed cable with fibre-glass outer covering which is more resistant to mold growth and rot; a neoprene jacket (instead of cotton or other fabric) for cables with fibrous conductor insulation; production of aluminum building wire (No. 12 insulated to replace short supply of No. 14 copper conductors). Despite shortages the wire industry is doing a good job as evidenced by following figures: 1946 production of Type R wire—over five billion feet (previous high, four billion feet in 1941); non-metallic sheathed cable, now 115 million feet per month. Mr. Rolston urged that voltage drop—not merely current carrying capacity—be considered when selecting conductor sizes. Concerning aluminum wire, he warned that the *current carrying capacity* is 84 percent that of copper; that many wiring devices will not accommodate the larger size aluminum conductor necessary; that electrolytic action will take place where copper and aluminum are connected together. These are points that must be considered by contractors and inspectors when they encounter use of this new wire during this era of material shortages, he concluded, adding that many of the problems are now being solved by some wire and solder manufacturers.

An illustrated talk by R. W. Wilson, manager, commercial service Kentucky Utilities Co., gave inspectors an insight into the effects of over-loading and voltage drop on residential wiring systems and current utilization. Using a demonstration board with a scale plan of a house including lamps of wattages actually used in various rooms, toasters, etc., Wilson projected light meter readings on a screen to show drop in light output of an ordinary table lamp when overloads were present.

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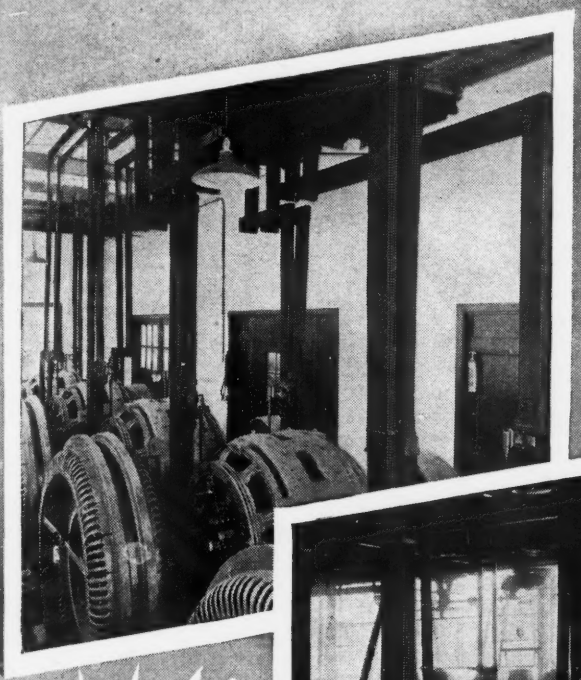

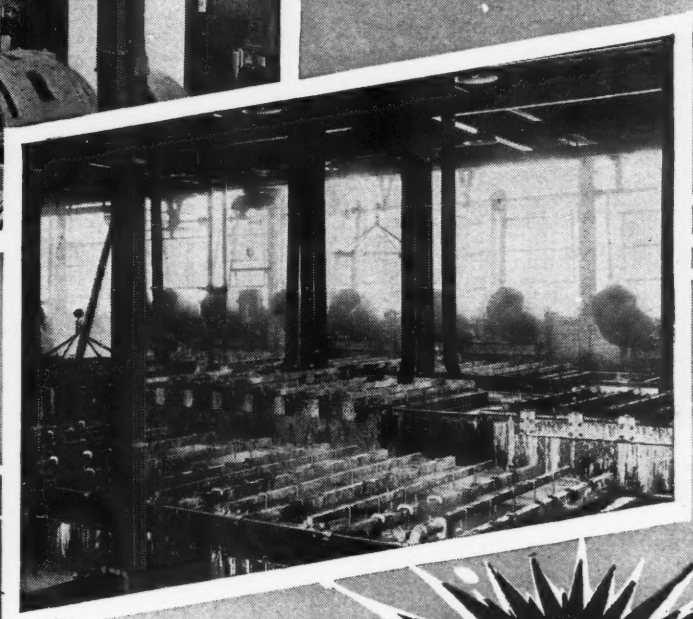

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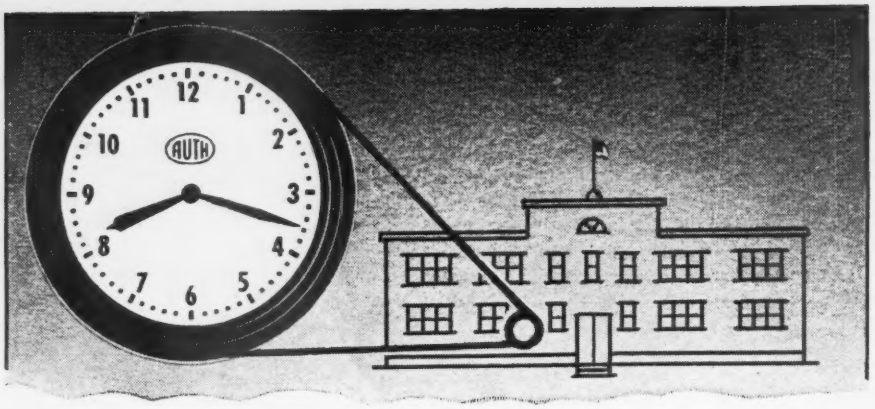

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TO KEEP SCHOOLS RUNNING SMOOTHLY

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Every detail of Auth signaling devices means longer life, greater mechanical strength, beauty both in architecture and tone, and easy installation.

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Auth program clock systems and elapsed time indicators are ideal for industry. Also, look to Auth for supervisory alarm panels and a complete line of bells, chimes, buzzers, horns and telephones.

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SINCE 1892

R. D. MacDaniel, past-president, Western Section, IAEI; and B. C. Hill (right) international president, IAEI from Oakland, Calif., chat about association activities at recent inspectors convention in Cincinnati.

L. L. Call, General Electric X-Ray Corp., Chicago, reviewed circuits and application of various x-ray equipment; H. M. Dreher, NEMA, discussed recent developments in armored cable; J. J. Siddall, H. H. Robertson Co., Pittsburgh, related the value of research to the engineer, the consumer and the public in general. D. E. Bowden, General Electric Lamp Dept., Nela Park, outlined a lighting sales program for the electrical contractor the most logical person to give the customer a complete lighting service. Bowden enlisted the inspectors' aid in promotion of this plan and invited them to attend meetings in their respective localities.

One of the highlights of any inspectors meeting is the "problem" session. Derating of switches (carry less than rated capacity because of fuse heating) was a subject of considerable discussion. According to representatives of the Frank Adams Electric Company, the nub of the trouble lies in the use of large renewable fuses which will melt out on full-load cycle (turned on and off) operation; the use of fuse-metal instead of copper connections on the renewable links; the improper relinking of such fuses. The only way to handle rated load on switches 200-amperes and over is to use one-time fuses, asserted the Adam Company men. A table of suggested lug sizes for 400 ampere and over stock switches, to comply with the conductor ratings in the new Code, was submitted by this company and referred to a Western Section, IAEI committee for consideration.

Concentric knockouts in switch and panel cabinets came in for another bout and apparently took the count. General concensus of inspectors and contractors present was that they are a general nuisance and should be eliminated. Contractors preferred to cut their own

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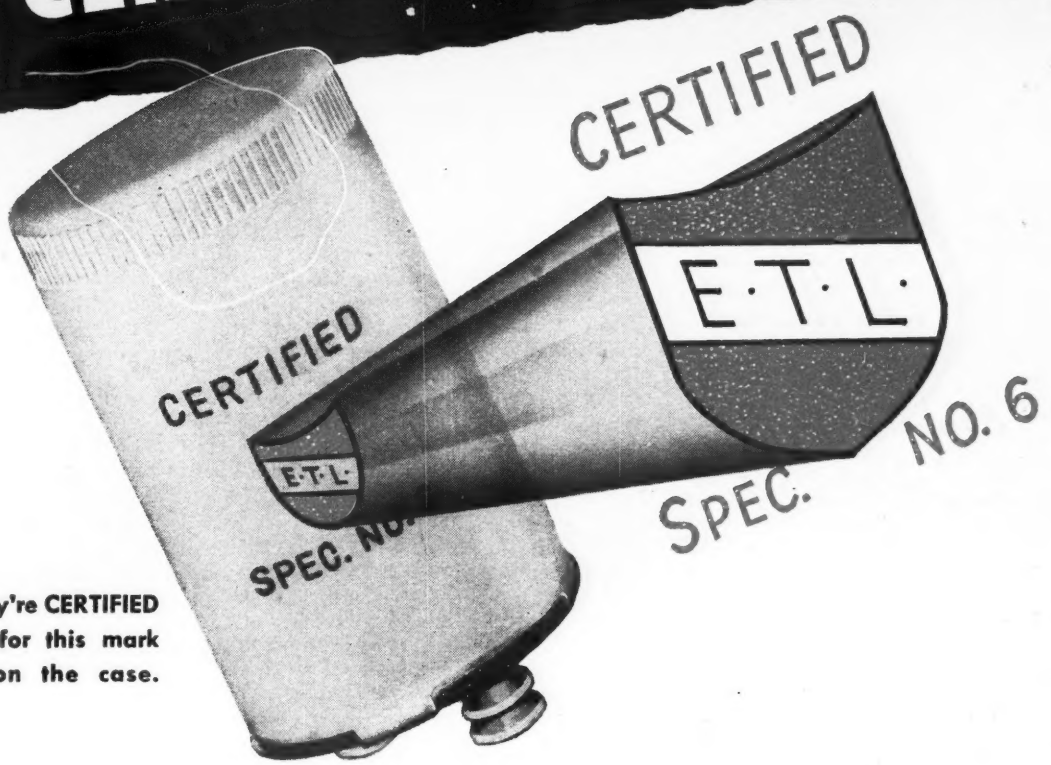

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And Certified Starters are subject to regular and special rechecks under actual operating conditions . . . double assurance to you that the fixtures you sell will deliver longer lamp life, and better lighting service.

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Fluorescent lighting is quick to win friends . . . and the *starter* you sell can do a lot to make it a LIFETIME friendship.

You'll "build character" with customers *fast,* when you show how simple it is to end the blink problem, once and for all, by installing Watch Dog* starters.

Watch Dog starters contain a built-in cutout that takes failing lamps off the line *at once,* as soon as their useful life ends. Multilamp luminaires can be kept lighted; relamping need not be rushed at an awkward moment. What's more, the Watch Dogs protect the ballast and reduce complaints of short starter life.

When a customer wants a few "replacement" starters, tell him the Watch Dog story. He'll see the advantage of installing Watch Dog starters *throughout.*

There's a Watch Dog starter for all fluorescent lamp sizes — one of a full line of G-E accessories to help you and your customers make the most of fluorescent lighting. For more information, write to Section G25-128, Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Conn.

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GENERAL ELECTRIC

Among Louisville, Ky., representatives at recent Western Section, IAEI meeting in Cincinnati were: (L to R) R. H. Scherzer, chief electrical inspector; Charles Wootan, chief engineer, Louisville General Hospital; Ray F. Tillman, The Brecher Company; A. F. McLain, ass't city electrical inspector; and M. M. Broida, Tri-City Electric Company (contractor).

knockouts on stock items and inspectors like the better bond such construction affords.

At the final business session the following officers were elected: President —A. H. Welklin, Ft. Wayne, Ind.; first vice-president—R. C. Loughead, Detroit, Mich.; second vice-president —W. C. Cale, Toronto, Canada; secretary-treasurer—F. H. Moore, Indianapolis, Ind. New appointments to the executive committee include: For one year—A. H. Welklin, Ft. Wayne; M. V. Reagan, Kansas City; O. K. Coleman, Lafayette, Ind.; O. A. Glasgow, Minneapolis. F. H. Moore, Indianapolis, and J. C. Denner, Saginaw, were elected for three-year terms.

The Western Section went on record, through resolution, opposing the action of the Board of Directors, NFPA, in removing the mandatory date for enforcement of the use of the Type S fuse. Such action, the Western Section believes, discredits the Electrical Committee, the National Electrical Code and the process of its formulation throughout the entire country.

Southern Inspectors Study New Code

The Eighteenth Annual Meeting of the Southern Section, IAEI was held at the George Vanderbilt Hotel, Asheville, N. C., Oct. 14-16. More than 220 inspectors left the conference with a better understanding of the import of the new 1947 National Electrical Code.

Like all section conferences this year, the major portion of the three-day session was devoted to an analysis and interpretation of code changes. Article Committee chairman outlined the new regulations and invited discussion.

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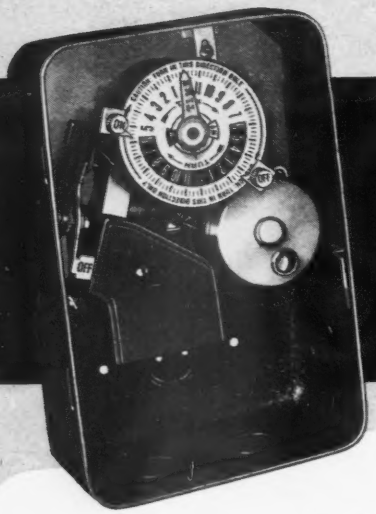

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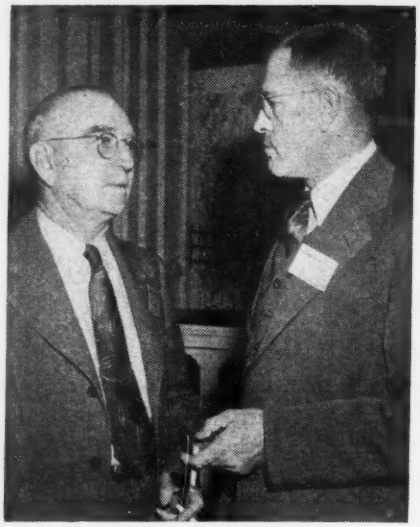

The importance of electrical safety is aired by Clifford Anderson (left), Oklahoma Inspection Bureau, Oklahoma City; and E. P. Hodges, Public Service Co., of Colorado, Denver at Western Section, IAEI Conference.

B. C. Hill, International President of Oakland, Calif., related the progress made in the electrical industry and safety standards, a development he has closely followed during his 34 years in the electrical inspection field. In his opening address to the conference, he urged return to pre-war wiring and installation standards; better recognition of the electrical inspector and his responsibilities to the community; a larger active membership and financial independence of the International Association.

The functioning of the Electrical Committee, NFPA and evolution of the 1947 electrical code was explained by V. H. Tousley who advised that the effective date of the 1947 code (will mark the 50th anniversary of the NEC) would probably be January 1st. Delegates used an Analysis of the 1947 Code Revisions to follow specific article discussions.

Article discussions usually invoke considerable reaction from the floor, and this session was no exception. Questions, answers and suggestions were numerous and varied. Among those recorded were:

Although the new code requires a 3-pole grounded receptacle in the laundry, it does not require installation of a ground wire to the water pipe, nor the supply of a three-conductor cord and plug on the appliance. The receptacle must also accommodate a two-prong plug.

Does a store with an all-glass front have a show window? Opinions varied on this and the Section was asked to prepare and submit a suitable definition of "show window".

Type TW insulated conductors can be installed in underground conduits;

J. D. Foley, meter supt. Ohio Edison Co., Youngstown, and W. A. Link (right), Tafel Electric and Supply Co., Louisville, Ky., talk material procurement at Western Section inspectors' meeting.

is approved for use in raceways exposed to oil, but not in locations where gasoline is prevalent. (U. L. tests for such not yet completed).

B. Z. Segall, New Orleans Public Service Co., suggested a table in the new code similar to Table 7 in the 1940 edition for rewiring in existing raceways and was promptly asked to compile one for publication in the News Bulletin.

Under the new code fluorescent fixtures must carry a nameplate showing voltage, frequency and current rating of units using ballasts or transformers.

Although most inspectors present approved of Section 4307 (wiring space in motor controller and disconnect enclosures) they felt it might be difficult to enforce it.

To determine classifications in hazardous locations, each room or area must be considered independently. Some inspectors suggested that Article 500 include explanatory illustrations; others felt that a separate pamphlet covering only this article would answer the problem.

At present, U. L. lists approved sealing units only for Type R wire, hence Type T would not be acceptable for use in most parts of bulk gasoline stations.

Discussion of Article 730 (outside wiring) brought out apparent inconsistencies in limits of span lengths for various sized conductors.

R. H. Luscombe, Penn Electric Switch Company, demonstrated application of new Code Article 725 (Remote Control, Low-Energy Power and Signal Circuits) to automatic control of domestic heating systems and outlined sections of the circuits which were covered by the Class 1 and Class 2 designations. Numerous inspectors present felt that, contrary to Code re-

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ON
FLUORESCENT LAMP BALLASTS

When a label is familiar to a buyer, it is usually because the organization so identified is long-established in its particular field.

Chicago Transformer ballasts can boast of three such labels—the C.T.C. emblem, a trademark of manufacturing experience, plus the U.L. and E.T.L. insignias, trademarks of two recognized testing laboratories.

C. T. C.—*Manufactured by Chicago Transformer.*
U. L. —*Approved by Underwriters Laboratories.*
E. T. L.—*Certified by Electrical Testing Laboratories.*

. . . Three labels to look for on fluorescent lamp ballasts, because ballasts bearing them win confidence for the lighting equipment in which they are installed.

CHICAGO TRANSFORMER
DIVISION OF ESSEX WIRE CORPORATION
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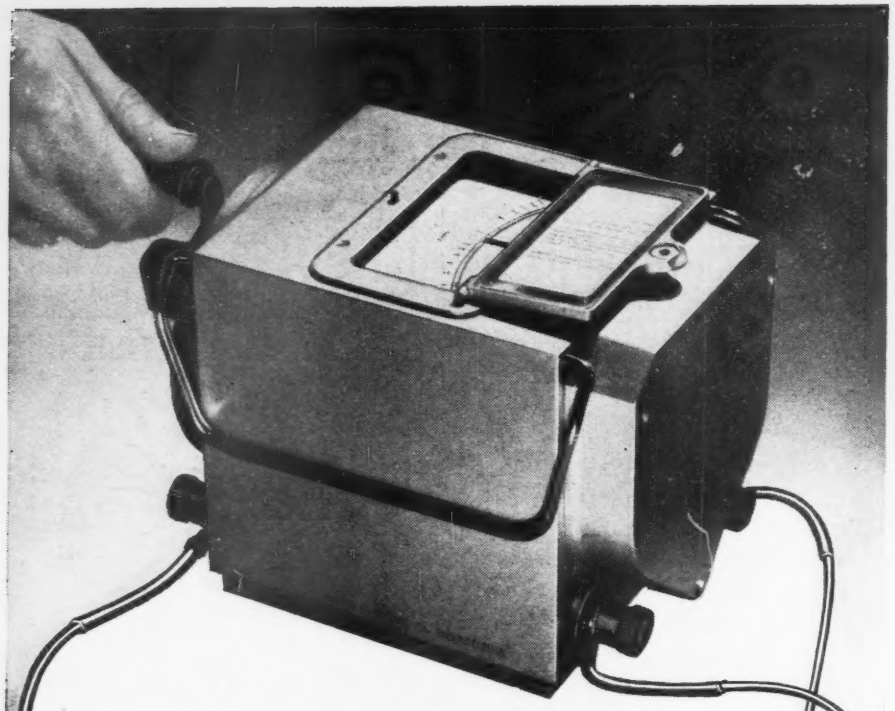


"MEGGER"* GROUND TESTER

The "Megger" Ground Tester measures resistance to earth of ground connections, quickly, easily and accurately. Simply connect the instrument to the installed ground and to two reference grounds, turn the crank and read resistance directly on the scale. Unaffected by polarization, electrolysis, stray earth currents or by the exact location or resistance of the auxiliary ground connections. Ranges from 0-3 ohms to 0-30,000 ohms.

"Megger" Ground Testers are invaluable for determining the nature of ground connections, and whether they are in condition to perform the service for which they are designed and installed. During the past 15 years these instruments have become standard equipment among many power companies, railroads, telegraph and telephone companies and industrial plants throughout the U. S. A. They are as rugged, reliable and simple in operation for ground resistance measurements as are our "Megger" instruments for testing insulation.

Write for illustrated Technical Bulletin on Ground Resistance Testers No. 1285-EC.

*Trademark Reg. U. S. Pat. Off.

James G. BIDDLE CO.
ELECTRICAL & SCIENTIFIC INSTRUMENTS
1316 ARCH STREET • PHILADELPHIA 7, PENNA.

Swapping experiences during Western Section, IAEI conference are (L to R): Claude Bawden, Underwriters Laboratories inspector, Youngstown, Ohio; and H. P. Van Tress, chief electrical inspector of Springfield, Ohio.

quirements, low-voltage thermostat circuits should be installed in a more reliable manner (Code permits open wiring). Many revealed that local ordinances require standard wiring methods.

A new armored cable, with a flat strip of bonding wire on No. 12 and No. 14, will soon be on the market W. M. Dreher, NEMA, New York City, revealed. Recommendation for this improvement originated in the Southern Section, IAEI, he stated, adding that armored cable fittings are now being manufactured by the thousands and should be available soon.

Many of those present were treated to their first view of the film "The Magic of Fluorescence" depicting the step by step manufacture of fluorescent lamps. Showing the film were Messers Knoderer and Parks of the General Electric Company.

Two and one-half million copies of "Electrical Safety in War Time" were circulated in schools, clubs, etc., by the Public Relations Committee, IAEI, reported L. B. McConaghy, New York City. A new booklet on over-current protection—particularly the 15 ampere fuse—will soon be released, he added.

At the annual business session, the Section accepted, with regret, the resignation of Frank G. Camus, chief electrical inspector of the city of Shreveport, and second-vice-president, IAEI. Mr. Camus is forming his own electrical contracting firm.

The Section, by resolution, protested the action of the Board of Directors, NFPA, in removing the mandatory date for enforcement of the use of the Type S fuse. General concensus was that such action discredited the Electrical Committee, the National Electrical Code and its formulation throughout the entire country.

Officers elected for the coming year include: President—M. G. Folkes, Richmond, Va.; first vice-president—B. Z. Segall, New Orleans; second vice-president—A. E. Hancock, Austin, Texas; secretary-treasurer—A. M. Miller, Richmond, Va. Members of the Executive Committee are: Chairman—C. S. Whitaker, Durham, N. C.; L. A. Turnage, Hartsville, S. C.; C. V. Porbes, New Orleans, La.; C. G. Butler, Decatur, Ga.; and B. A. Blakey, Jr., Montgomery, Ala. Elected to the Executive Council, IAEI were: A. J. Bommer, Dallas, Texas; and J. G. Fisher, Jackson, Miss. Representing the Section on the Electrical Committee are N. E. Cannady, Raleigh, N. C.; and J. G. Fisher of Jackson, Miss.

Eastern Inspectors Meet in Elmira

The 22nd annual meeting of the Eastern Section of the International Association of Electrical Inspectors was held at the Mark Twain Hotel, Elmira, N. Y. on October 28-30. Registration totalled over 200.

P. J. Hicks, president, presided at the opening meeting. He said that the Code can be improved by continued study in Chapter meetings, and also by a better exchange of ideas between the five sections of the IAEI. He questioned whether the introduction of new items helped business, bringing as it does, new and additional lines of fittings. Governmental inspectors should be better represented and be more active in the IAEI, declared Mr. Hicks.

International President B. C. Hill of Oakland, Calif., stressed that associations which cooperate in unselfish constructive works are bound to be successful. The 6,000 members of the association have made a substantial contribution to the National Electrical Code. Mr. Hill urged a larger active membership; financial independence of the organization; just recognition and compensation of the electrical inspector.

Victor H. Tousley, electrical field engineer, NFPA, and secretary-treasurer of the IAEI, Chicago, explained that copies of the new 1947 National Electrical Code were not available because strikes had delayed its printing.

William J. Walker of IBEW addressed the meeting on "The Code Today". He asked for a united industry but said it cannot exist today when labor and management each thinks that the other wants to destroy industry. American business should be free of its fears of government in-

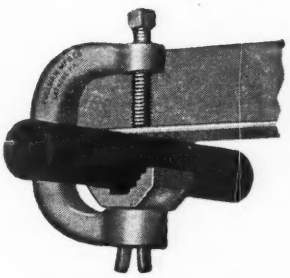
FULLMAN Latrobe PRODUCTS

FLOOR BOXES ★ WIRING SPECIALTIES

FULLMAN MANUFACTURING CO. QUALITY AT LATROBE SUPREMACY LATROBE, PA.

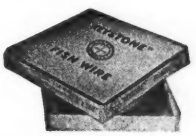
Outstanding Performance Keeps Latrobe Products Sold

Quick, labor-saving installation may frequently be the primary factor in the sale of Latrobe Floor Boxes and wiring specialties. But its their uncommon fine performance that keeps them sold year after year.



No. 470 "Latrobe" Pipe or Conduit Hanger

Convenient for hanging pipe or conduit ½", ¾" and 1" to steel beams up to ⅜" thick—or for use as ground clamp.

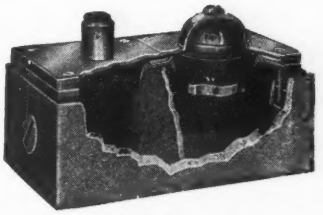


Keystone Fish Wire

Flat steel wire of high quality and properly tempered.

"Bull Dog" Insulator Support

Quick and efficient for fastening porcelain or glass insulators to exposed steel framework.



No. 252-R Floor Box

Sturdy and practical Two Gang Box with No. 208 Receptacle in one section. One Cover Plate has ½" Brass Plug and one has 2" Brass Plug.

No. 110 "Latrobe" Watertight Box

Iron box body with 3½" round Brass Cover Plate. Shown with No. 208 Receptacle and 207 Ball Nozzle.

"Bull Dog" BX Cable Staples

Excellent quality staples. Packed in Cartons, Kegs and Barrels.

FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA

An Amazingly Convenient New Kit of

Wedge-Grip Connectors

List Price Per Kit

$4.80

Master Electrician's
Sherman "Wedge-Grip"
SERVICE KIT
"Wedge-Grip"
The Pressure Connector of a Hundred Uses
FIXTURES, JUNCTION BOXES, SERVICE ENTRANCE, OUTLET BOXES, FRACTIONAL H. P. MOTORS, CONNECTING LARGER MOTORS, ELECTRIC RANGES AND SCORES OF OTHER PRACTICAL USES
PRICE Per Kit
$4.80
Saves Time—Cuts Costs
Made by H. B. SHERMAN MFG. CO. Battle Creek, Mich.
The Sherman "Wedge-Grip" SERVICE KIT
CONTENTS
10 No. SC6 "Wedge-Grips"
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5 No. SC6 "Wedge-Grips"
Total of 55 "Wedge-Grip" Connectors
10 No. SC6X "Wedge-Grips"
10 No. SC12X "Wedge-Grips"
5 No. SC2X "Wedge-Grips"

50 YEARS 1896 S 1946 OF LEADERSHIP

Here's a handy kit that slips into the electrician's tool bag, and provides the right size Sherman Wedge-Grip Connector for No. 18 through No. 2 standard wire. A marvelous time saver. Eliminates those bothersome, slow soldered splices.

Kit contains 55 high quality Wedge-Grips, made of pure, hard drawn copper, with oval pointed bronze screws that wedge wires securely between V-shaped corrugations. Screws have slotted hex heads.

Order a stock of these new Wedge-Grip Kits today!

H. B. Sherman Mfg. Co.
Battle Creek, Michigan

"Wedge-Grip"

The Connector of A Hundred Uses

The Wedge-Grip is a splendid connector for fixtures, junction boxes, service entrance, outlet boxes, small and large motors, electric ranges, etc.

Hundreds of Master Electricians are using this famous pressure connector in residential, commercial, and industrial work.

Order **Sherman**

"WEDGE-GRIP" Kits From Your Wholesaler!

terference and of the attitude of labor.

A report was made by Allan Coggeshall of the National Electrical Contractors Association on Articles 210 and 220, Wiring Design and Protection. New branch circuit ratings are 15, 20, 30 and 50 amperes. Show window loads are to be computed at either 200 watts per linear foot or 1½ amperes per outlet in the branches, and at 200 watts per foot for the feeders. The Code will have new tables of range demands, with a range neutral demand factor of 70 percent.

Services, Article 230, were explained by A. E. Pringle II, a member of the Electrical Committee. References were made to the following new sections: 2303-b, c, and d, allowing thermoplastic insulated conductors; 2304-a which recommended a minimum of three No. 6 wires for services; 2351-d and 2371-c, new rules on what was known as the master service; 2322 on clearance of service drops; 2337 which requires the service head to be above the attachment of the service drop to the building; 2358 requiring solderless lugs in the service; and 2389, changes in the high voltage rules.

An address on adequate wiring was given by E. S. Northrup of the National Adequate Wiring Bureau. The value of this program to each branch of the industry was shown by slides, pointing up to the need of planned community action, backed by the NAWB, that the public may be made conscious of the fact that it must be prepared to spend something for wiring before many appliances can be served.

F. N. M. Squires, IAEI member on the Electrical Committee, explained section 2403-a requiring that screw shells of plug fuseholders be connected to the load side of the circuit; section 2405 which will necessitate an overcurrent unit in each hot leg of circuit breakers; section 2440 which makes mandatory the installation of switches ahead of cartridge fuses; section 2452, the Type S fuse, which the Code made mandatory, later to be held in abeyance by the Board of Directors of NFPA; and the deletion of the need for fusing the white wire of unpolarized circuits.

A. H. Schirmer, chairman of the Article 250 Committee of the Electrical Committee, explained the new grounding rules. Section 2554 requires a common electrode to be used for both wiring system and equipment. Range frames may be grounded to the neutral under new section 2560.

The work of Underwriters' Laboratories, Inc., was explained by M. M. Brandon, Chief electrical engineer.

A presentation of the 1947 Code as applied to Automatic Heating Systems, was made by W. W. Martenis, Chair-

man of the NEMA Committee on Domestic Automatic Controls. He told of the functions of the line switch, thermostat, primary controls, and their relative importance in the wiring of oil burners.

A demonstration of explosion hazards was given by R. M. L. Russell, engineer, Factory Insurance Association. The explosive range of gases and dusts was demonstrated by actual explosions.

Insulation was discussed by Samuel Rosch, engineer, Anaconda Wire and Cable Company. The 1/32d inch wall of rubber to be adopted in the 1947 Code has been in use in Britain for decades.

The Code breakfasts were highly successful in getting the group together first thing in the morning. These discussions were led by B. A. McDonald, John M. Turnbull and M. M. Brandon.

Officers elected for the coming year were as follows: President, E. T. Quinn of Newark, N. J.; first vice president, H. H. Daniels of Washington, D. C.; second vice president, B. A. McDonald of Rochester, N. Y.; secretary, F. N. M. Squires; and Treasurer, A. W. Hopkins. Besides the officers of the Section the following were elected to the Executive Committee: Active member, J. D. Lynett; Associate member, W. J. Canada; Cooperative member's representative, C. A. Gerlepsch; representatives to the IAEI Executive Council were elected for three years: P. J. Hicks, Jr,. F. N. M. Squires; and for one year, H. H. Daniels.

New NISA Chapter Approved

Organization of a Great Lakes Chapter was approved at a recent meeting of the NISA Executive Committee at the Prince Edward Hotel, Windsor, Ontario. The new Chapter will have jurisdiction over the lower peninsula of Michigan and Southwest Ontario.

Camus Starts Contracting Firm

Frank G. Camus, chief electrical inspector of Shreveport, La., recently resigned his position to start his own electrical contracting firm. Mr. Camus was an active member of the International Association of Electrical Inspectors since 1935; held numerous offices in the Southern Section and was second vice-president, IAEI at the time of his resignation.

How to
SELL MORE
Poultry
time switches

Stock the New Paragon PS-30 and "talk" these Unbeaten Features

1 The new PS-30 provides . . . better than any other switch . . . both morning and evening poultry house lighting with dimming period for roosting. Lighting stimulates hormones, increasing egg production without increasing feed consumption . . . when egg prices are highest.

2 The PS-30 provides uniform work day throughout winter and summer . . . plus week-end leisure for owner and family group.

3 Telechron Motored. Lowest priced complete Poultry Time Switch. . . . . $12.75 LIST

Write for sales aids. Paragon designs and manufactures Time Controls for every need

PARAGON ELECTRIC COMPANY
1614 TWELFTH STREET
TWO RIVERS,
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Paragon Two Rivers WISCONSIN
BUILDERS OF ELECTRICAL EQUIPMENT SINCE 1905

RELIANCE AUTOMATIC TIME SWITCHES

Model "W"

Completely automatic . . . extremely simple, compact, economical . . . three types cover practically every requirement . . .

ASTRONOMIC TIME SWITCH

● The Model "W" Astronomic types are particularly popular for advertising illumination. The "on" operation changes daily to correspond with local sunset time, eliminating the necessity of re-setting the dial as the days become longer or shorter.

AMERICA'S RELIABLE 24 hour-a-day GUARDIANS

RELIANCE Time Switches have proved their dependability. They give complete and reliable service under many varied conditions—a factor of paramount importance when constant good service is essential. Send for catalog and price sheets for complete details.

RELIANCE AUTOMATIC LIGHTING CO.
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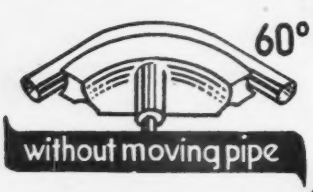
Bend Conduit Cold—

Here's How

up to 90 degrees in one single operation with Tal's Prestal Pipe Bender

Conduit can be bent 40° to any desired angle

60° without moving pipe



90° in one operation

Installation work goes faster, easier, and at a lower cost when you have a Tal's Prestal Bender on the job. This efficient, light, portable machine handles all pipe and conduit up to 3". Makes perfect bends, up to 90°, cold, in one single operation. No need to waste labor by replacing the pipe three to six times to make a bend. Does a good workmanlike job — smooth, uniform bends without kinks or wrinkles. Simple and easy to operate. Thousands are in successful use everywhere. Write for data bulletin.

Tal's Prestal Bender, Inc.
Dept EC-12, Milwaukee 2, Wisconsin

Southwestern Group IAEI Meets

At the code breakfasts the electrical inspectors let down their hair; in the formal session they discussed the changes in the National Electrical Code. Such was the situation at the annual meeting of the Southwestern Section, International Assn. of Electrical Inspectors at Sacramento, Sept. 30, Oct. 1 and 2, presided over by M. C. Sandles, retired, former chief inspector, Oakland.

For the formal sessions, the program had been arranged by secretary-treasurer Harold L. Gerber, chief inspector, San Francisco, to review the changes in the 1946 edition of the National Electrical Code. Even the corollary speakers from the industry were assigned subjects in relation to particular phases of the new code. The new code rules regarding load center distribution were covered, for instance by V. E. Dobson and William H. Schiek of General Electric Co. Harvey N. Skow, of Westinghouse, followed with a discussion of transformer network and load limiter ties as outlined in Article 450 of the code. Paul Neese, Perfex Corp., Milwaukee, likewise diagrammed and explained the applications of Article 725 of the code. Other industry speakers were L. B. McConaghy of the cord section of NEMA, H. M. Dreher of the armored cable section of NEMA and Joseph Siddall, manager, H. H. Robertson Co., spoke on research and the electrical inspector.

The Type-S fuse came in for more discussion, particularly with reference to a recent action of the board of directors of the National Fire Protection Assn. in overriding the vote of the Electrical Committee and again delaying the mandatory provision for the Type S fuse. A resolution presented at the Northwestern Section was echoed by the passage of a similar resolution by the Southwestern Section. Criticism was also leveled at the panelboard manufacturers for not equipping their panelboards with the Type-S fuse receptacles.

C. McClelland, safety engineer, Division of Industrial Safety for State of California, was very critical of the careless way in which temporary wiring is permitted to be done during construction with wornout materials, hazardous and unprotected sockets, no attempt at grounding of portable tools, etc. Likewise criticized were traveling carnivals and shows whose electrical equipment is allowed to run down and become hazardous.

At the election of officers, Larry Trim, chief inspector, Burbank, Calif., was elected president, H. C. Moore, Mo-

desto, first vice-president; J. K. Ross, San Bernardino inspector, second vice-president; and H. G. Ufer, Underwriters Laboratories, western superintendent, secretary-treasurer. To the executive committee were named M. C. Sandles, past president; H. V. Dobson, Santa Barbara; H. K. Winterer, General Electric Co., Los Angeles and J. A. Hill, Pacific Gas and Electric Co., San Francisco. B. C. Hill was re-elected representative on the Electrical Committee with F. A. Short, Los Angeles, as alternate, and Arthur Veit, county electrical inspector, Los Angeles, a member of the executive council.

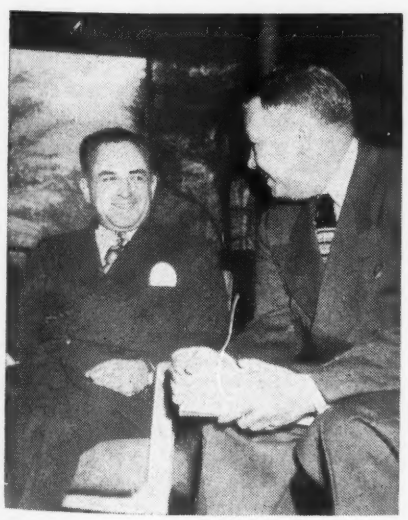
Lighting Equipment Leaders Meet at NELA

What will the portable lamp and lighting fixture of tomorrow look like? How soon will these long-looked-for units be made generally available?

These and many other timely questions were tackled at General Electric's Nela Park, November 11 and 12, when representatives of the nation's leading lighting equipment concerns huddled for the first time since before the war.

More than 150 representatives of 60 portable lamp makers attended the November 11 symposium. Some 200 representatives from 85 of the nation's top manufacturers of lighting fixtures for the commercial, industrial and residential fields attended the special symposium on November 12.

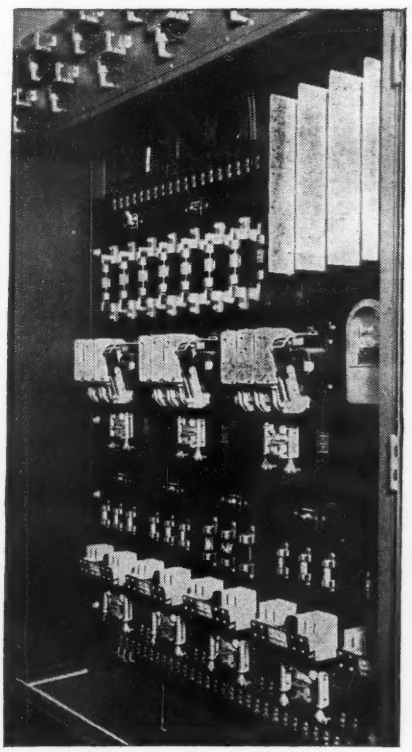
Purpose of the symposium meetings was to permit joint study of new equipment design ideas, of material shortages, of market trends, and of new proposals designed to achieve maxi-



S. C. Sachs of S. C. Sachs Co., St. Louis, Mo., chats with E. D. Stryker at Nela Park, Cleveland.

Specialists in CUSTOM-BUILT MOTOR CONTROLS

For over 50 years we've been specializing in the design and construction of *unusual* electric motor controls. This means building *your* specifications and *your* requirements into specialized controls of all types, for all purposes—including printing presses, machine tools, synchronous motors, pumps, laundries, ventilating fans, dairies and many more.



A wide range of industries are served by Monitor. Above you see a partial view of a Monitor installation in a leading Kentucky theatre where the problem was heating and air conditioning.

So if your motor control problem is "out-of-the-ordinary," be sure to consult your nearby Monitor Field Engineer. His specialized knowledge will save you time, money and headaches in working out unusual control arrangements on present products and new product developments. Representatives in all principal cities.

If it's custom-built...

MONITOR

builds it better!

The Monitor Controller Company

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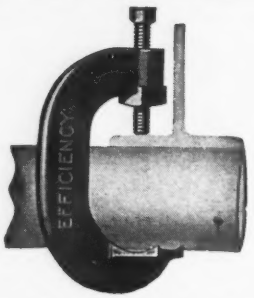
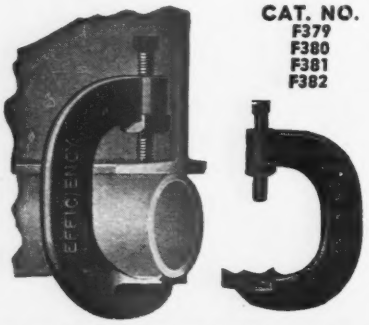
CANADIAN AFFILIATE • CANADIAN CONTROLLERS LTD • TORONTO, ONTARIO, CANADA

"EFFICIENCY" DEVICES FOR CONDUIT AND CABLE SUSPENSION

EFFICIENCY CONDUIT HANGERS
FOR
INDUSTRIAL CONSTRUCTION



● The most practical and widely adaptable hanger ever devised for supporting conduit or armored cable on open steel construction. Will carry pipe at any angle to beam.



CAT. NO.
F379
F380
F381
F382

Highest grade malleable iron, guaranteed against breakage. Set screw, cup pointed, tightened by free nut, plus 5-point radiating ridges of gripping surface holds pipe on true mechanical principle, guaranteeing a solid, non-slip support.

FOR PIPE AND CABLE SIZES
For armored cable
For ½" and ¾" conduit
For 1", 1¼" and 1½" conduit
For 2" and 2½" conduit

WRITE TODAY for our Catalog No. 38 . . . contains complete information on this and other EFFICIENCY Electrical Devices

Efficiency ELECTRIC AND MANUFACTURING CO.
MANUFACTURERS OF EFFICIENCY ELECTRICAL DEVICES FOR CONDUIT, WIRE AND CABLE SUSPENSION
EAST PRESTON, ONT.

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FOR ANY JOB—ANYWHERE

Onan ELECTRIC PLANTS

ONAN ELECTRIC GENERATING PLANTS supply reliable, economical electric service for industrial uses, as well as for scores of other general applications.

Driven by Onan 4-cycle gasoline engines, these power units are of single-unit, compact design and sturdy construction. Suitable for mobile, stationary or emergency service.

Capacity range: 350 to 35,000 watts; 115 to 660 volts A.C., 50 to 800 cycles; 6 to 500 volts D.C.; combination A.C.—D.C. types.

Write For Folder 690 describing complete Onan Line

Model shown is from W2C series. 2000 to 3500 watts; powered by Onan two-cylinder, water-cooled engine.

D. W. ONAN & SONS
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mum output of lighting equipments in minimum time. Serving as chairman for both meetings was E. D. Stryker, Nela Park sales executive.

Highlights of the program for the portable lamp makers group included: study of new designs; of prevailing design problems; discussion of availability of lamps and lamp parts; several addresses on the various lamp markets by leaders in each field; talks by top executives of such related organizations as the certified lamp, lamp and shade, and better-light-better-sight groups.

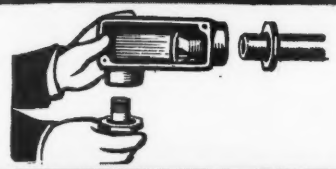
S. C. Sachs, electrical contractor of St. Louis, Mo., discussed the fixture market as viewed by contractors. He said that the fixture market is a tremendous one and is part of all construction whether it be residential, commercial, industrial, modernization, alteration, or all types of new structures. Mr. Sachs believes that the merchandising end of lighting is overemphasized by all segments of the industry. If we can place the proper emphasis on use factors, proper planning and scientific approaches, the merchandising will take care of itself, he continued.

The demand for relighting at the present time is enormous, Mr. Sachs said, but the difficulties in obtaining materials and equipment together with manpower shortage cause contractors to walk down alleys to avoid getting an order. He believes that the manufacturer should consider in the design of his products ease of installation and maintenance. This is particularly true in connection with fluorescent lighting, he continued, because the cost of installation is far in excess of what it should be.

DATES AHEAD

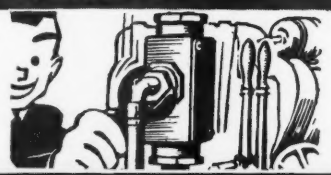
George Washington Chapter IAEI—Board Room, District Bldg., Washington, D. C., December 9.
American Institute of Electrical Engineers—Winter Convention, New York, N. Y., January 27-31, 1947.
Electrical Engineering Exposition—71st Regiment Armory, New York, N. Y., January 27-31.
International Heating and Ventilating Exposition—Lakeside Hall, Cleveland, Ohio, January 27-31.
National Electric Sign Association—Convention and equipment exhibit, Congress Hotel, Chicago, Ill., February 3-5.
Indiana Chapter, I.A.E.I.—Indianapolis, Indiana, Feb. 6-7.
National Association of Home Builders—Convention and exhibit, Stevens Hotel, Chicago, Ill., February 23-27.
National Electrical Manufacturers Association—Edgewater Beach Hotel, Chicago, Ill., Week of March 2.
Chicago Production Show and Conference—sponsored by Chicago Technical Societies Council, Hotel Stevens, Chicago, Ill., March 17-19.
North Central Electrical Industries—All-Industry Convention, Hotel Duluth, Duluth, Minn., March 17-19.
National Industrial Service Association—Annual Convention, Hotel Statler, Detroit, Mich., March 31, April 1-2.

They use RIGID and THIN-WALL conduit



They often have to CHANGE FITTINGS

Fittings must resist constant VIBRATION



What a Spot for KONDU!

Only with Kondu fittings can you use Thin-Wall Tubing at any outlet . . . and take one fitting out of the line and put in another, without disturbing conduit. And Kondu fittings hold permanently tight . . . vibration proof. Practically unbreakable . . . 100% re-usable.

Write for the Kondu Catalog.

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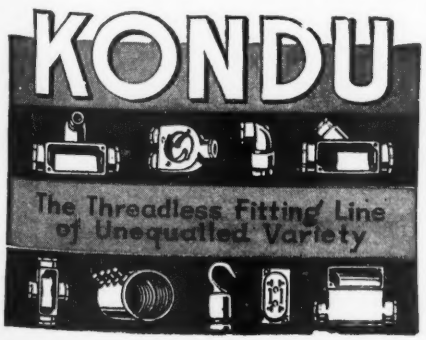
Erie, Pa.

KONDU MFG. CO. LTD., Preston, Ontario



New! KENNADRILL* Saves 7½ Man Hours in One Day FOR ELECTRICAL CONTRACTOR

Speeds Up **ROTARY DRILLING of Masonry**

- **TAKES HOLD QUICK!**
- **CUTS CLEAN!**
- **DRILLS FAST!**
- **CAN'T STALL!**
- **STAYS SHARP!**

Often an electrician *must* drill holes in brick, tile, stone, or cement preliminary to a wiring job. Time saved on such work enables skilled men to stay at their real trade and do easier, faster wiring. One electrical contractor using Kennadrills reports: "Saved 7½ man hours the first day we used the Kennadrill, which permitted us to move to another job a day ahead of schedule."

Kennadrills save time and labor drilling holes in *all types of masonry*. They replace the noisy, nerve-racking, tedious method of piercing with percussion drills, or hammer and chisel.

Inserted in any standard rotary electric drill they easily cut through all types of non-metallic construction materials—in a hurry. Here's why—they are tipped with Kennametal—the metal that is far harder and more durable than tool steel. It takes hold fast, cuts clean, drills true, and keeps a keen edge under the heat and abrasion of cutting.

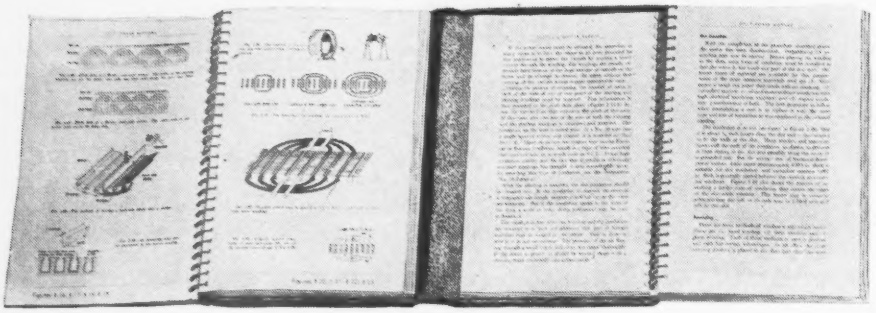
Available in following diameters: ¼", 5/16", ⅜", ½", ⅝", ¾", ⅞", and 1". Ask your jobber, or write for particulars and prices.

Distributors Wanted!
Write for particulars, telling us territory you cover.

*Kennadrills have cutting tips of the "magic metal" of the war—cemented hard carbides known as Kennametal, that helped America's metal-cutting industry to multiply its output at a fraction of previous costs.

KENNAMETAL
SUPERIOR CEMENTED CARBIDES
KENNAMETAL Inc., LATROBE, PA.

A Pair of Pliers . . . A Screw Driver and . . .



THIS BOOK

is all you need to repair, rewind, connect and assemble an electric motor

Split-phase, capacitor, repulsion-induction, polyphase, Direct current — All are covered in language and diagrams anyone can understand.
The student — the apprentice — the mechanic — the foreman and the engineer will save hours of experimenting, testing, tracing connections if this book is available.

The duo-spiral binding makes both text and illustrations visible at the same time and the complete index permits quick finding of the subject desired.

This book of 570 pages and 900 illustrations is a must for the mechanic who wants to know the right way, the quickest way to rewind and repair electric motors.

Electric Motor Repair $5.00+Postage

READING ELECTRIC COMPANY, Inc., 200 William St., New York 8, N. Y.

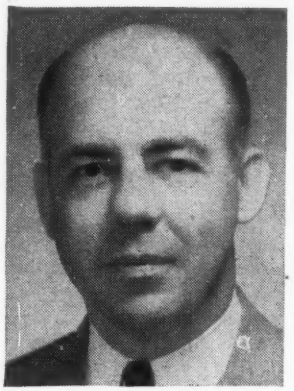
THE TOLEDO STANDARD COMMUTATOR CO.
THE HULLHORST MICRO TOOL CO.

3 FACTORIES
to serve you
TOLEDO · HOMER · HILLSDALE

Manufacturers News

W. R. SCHAFER SALES MANAGER OF IDEAL INDUSTRIES

Ward R. Schafer has been named general sales manager of Ideal Industries, Inc., Sycamore, Ill. Mr. Schafer was formerly vice president in charge of sales of Edison General Electric



W. R. SCHAFER

("Hotpoint") Appliance Company in Chicago. Except for two of the war years when he supervised construction of a $6,000,000 power plant for the Defense Plant Corporation in connection with the government synthetic rubber program, Mr. Schafer served with the appliance company from 1924 until the present time.

PIERCE RENEWABLE FUSES ELECTS L. R. POPP

At a meeting of the board of directors of Pierce Renewable Fuses, Inc., the following officers were elected—Wm. Brennan, Jr., chairman of the board; Louis R. Popp, president and general manager; Arthur M. Popp, vice president and general works manager; M. D. Popp, secretary and treasurer; and D. O. Granger, general sales manager.

HILL APPOINTED SALES MANAGER PNEUMATIC TOOL

Independent Pneumatic Tool Company of Chicago announces the appointment of J. A. Hill as manager of electric tool sales. Mr. Hill, formerly manager of its New York branch office, will now have his headquarters in the general offices at Chicago.

W. C. Rush, formerly in the St. Louis branch, has been appointed manager of the new Cincinnati office, located at 426 Elm Street.

McGILL LAMP GUARDS

PROVIDE

PROTECTION AGAINST BREAKAGE
PREVENTION AGAINST REMOVAL
ASSURANCE OF LONGER LIFE

FOR YOUR LAMPS

Designed for industrial, commercial and home uses, these guards are supplied in all sizes for regular or mill-type lamps, providing complete overall protection.

3 DURABLE MODELS

LOXON

LOXON — No. 1425 Lamp Guard, designed by McGill, locks on preventing unauthorized removal and breakage of lamps. Constructed with steel wire heavily tinned; available in sizes to fit all sockets, as well as regular and mill-type lamps. Used in garages, factories, yards, shops, basements, etc.

GRIPON

GRIPON — No. 1600 Non-Locking Guard prevents breakage and is similar in construction to the Loxon Guard except plain steel screws are used instead of locking screws. Easily detached for lamp renewal. Made to stand hard use, and for both regular and mill-type lamps.

PROTECTOR "O"

PROTECTOR "O" — No. 14333 Heavy Duty Guards for general construction work. Will stand hard use and abuse. Can be easily moved when required, from one job to another. Made of No. 10 steel wire, heavily tinned to prevent corrosion. The collar slips over weatherproof sockets generally used on outside work.

SEND FOR CATALOG

Electrical Specialties Catalog No. 43 giving full details, or ask your Wholesaler for McGill Products.

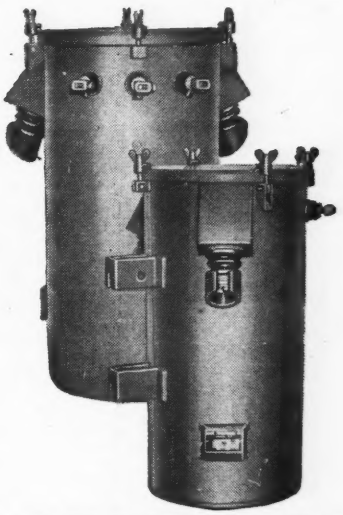
McGILL MANUFACTURING COMPANY, INC.
Electrical Division VALPARAISO, INDIANA

DAVIS TRANSFORMERS

POWER TRANSFORMERS

FOR EVERY UTILITY AND INDUSTRIAL REQUIREMENT

250 KVA, SINGLE PHASE
OIL COOLED 2400-480
(DISTRIBUTION TRANSFORMER)



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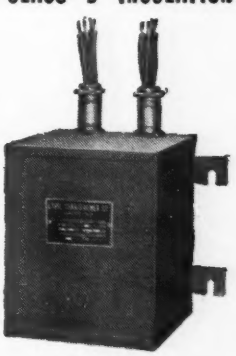
FOR DEPENDABLE SERVICE ON UTILITY AND INDUSTRIAL LIGHTING AND POWER APPLICATIONS

15 KVA, SINGLE PHASE
OIL COOLED 2400/4160Y–120/240

DRY TYPE TRANSFORMERS

FOR EVERY INDUSTRIAL APPLICATION BOTH CLASS "A" AND CLASS "B" INSULATION

Dry type distribution from 15 KVA through 100 KVA equipped for floor or wall mounting.

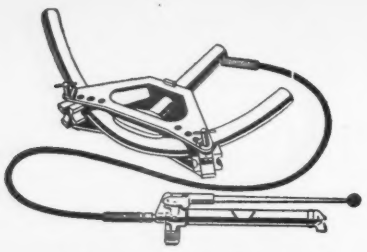


For power and lighting from 1 KVA through 15 KVA 230/460–115/230 equipped for wall, post or floor mounting.

DAVIS TRANSFORMER COMPANY

DAVIS TRANSFORMER CO.
Phone 177 CONCORD, N. H.
MANUFACTURERS OF OIL COOLED, DRY TYPE, POWER AND DISTRIBUTION TRANSFORMERS

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION NEMA MEMBER



When you buy a

BENDER

..check to make sure you get these features:

EASY TO GET TO THE JOB

☑ Lightweight, portable—one man can easily take a Blackhawk Pipe Bender right to the job. Bends rigid conduit and pipe in all popular sizes, up to 4" dia.

WORKS AT ALL ANGLES

☑ The compact hydraulic Porto-Power Ram is all-directional. Power eliminates need for heating the pipe.

WORK OVERHEAD

☑ All-directional operation and light weight enlarges range of utility to use on ladders, scaffolds and cramped quarters and work on existing pipe runs.

SIGHT FROM ANY ANGLE

☑ Remote control permits operator to stand in any position for a full view of the job. Saves need for elbows, couplings, cutting and extra threading.

DETACHABLE POWER UNIT FOR EXTRA UTILITY

☑ It pulls gears, lifts machinery, and licks scores of other trouble jobs.

BLACKHAWK Porto-Power PIPE BENDERS

BLACKHAWK MFG. CO.
Dept. P20116, Milwaukee 1, Wis.
Mail Hydraulic Equipment catalog to:

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COMPANY_____

ADDRESS_____

ALLIS-CHALMERS CHANGES

Charles F. Codrington has been promoted from assistant to the manager to sales manager of the blower and compressor department of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. He succeeds A. E. Caudle, who has resigned.

J. H. Hillman has been promoted from chief estimator and application engineer to assistant manager of the sales and engineering departments at the Norwood, Ohio plant. E. G. Brooker has been named as successor to Mr. Hillman.

Albert R. Kanuss, formerly of the Tulsa district office has been named manager of the branch office at Memphis, Tenn.

NEW CORPORATION FORMED

General Electric Appliances, Inc., a new corporation, has been organized to carry on the business formerly conducted by the nine G-E Appliance Distributing Branches. The corporation's headquarters are at Bridgeport, and the branches are located in Boston, New York, North Jersey (Bloomfield), Philadelphia, Pittsburgh, Florida (Jacksonville), Cincinnati, St. Louis and Los Angeles. Management and operating personnel of the branches remain unchanged.

Officers of the new corporation are: H. L. Andrews, chairman of the board; P. A. Tilley, president; W. D. Wood, vice president; Merrill Brown, secretary; L. E. Walkley, treasurer; W. E. Swinton, assistant treasurer; W. H. Pickett, assistant secretary; and R. F. Wieneke, assistant secretary and treasurer.

WESTINGHOUSE APPOINTMENTS

Joseph S. Parry has been appointed eastern district industrial manager of the Westinghouse Electric Corporation. C. Swan Weber has been named to succeed Mr. Parry as manager of the Westinghouse Newark, N. J., office at 1180 Raymond Blvd.

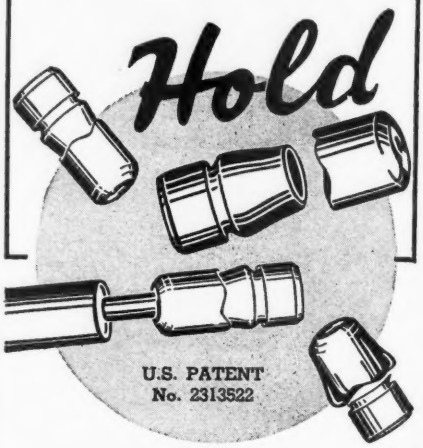
Richard M. Wilson has been named manager of the Westinghouse Washington, D. C. office.

RITTENHOUSE APPOINTMENTS

The Rittenhouse Company, Inc., Honeoye Falls, New York, has announced the appointment of Elmer C. Dvorak as vice president and a member of the board of directors, in charge of sales and advertising.

Lester D. Catlin has been named executive vice president and director of manufacturing of Rittenhouse. He will also serve on the board of directors.

SUPER EXPANSION ANCHORS



The new all steel Super Expansion Anchors are the answer for securely fastening conduit, switches, controls, lighting fixtures, signs and sign supports, etc.

Easy to install, will hold securely.

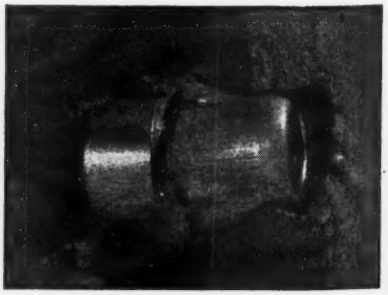
The new all steel S-A Anchors are Cadium plated for a long life.

The proven expansion of the steel cap has a biting action that really "holds for keeps".

The following sizes in stock for immediate delivery.

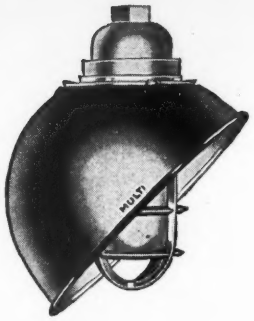
10 - 24	3/8 - 16
1/4 - 20	7/16 - 14
5/16 - 18	1/2 - 13

See your jobber or order direct from factory.



The photo shows the actual expansion of the anchor.

S-A Manufacturing
11080 Gratiot Ave.
Detroit 5, Michigan



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A COMPLETE LINE FOR ALL NEEDS

We can supply all your commercial, industrial, and residential lighting needs . . . install the best possible lighting for your customers and make every lighting job pay—guarantee every lighting job you install with MULTI units. This is the modern method for taking good care of your customers and relieving yourself of after worries.

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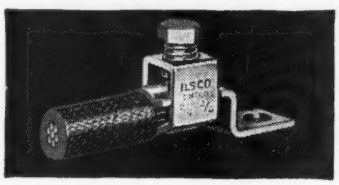
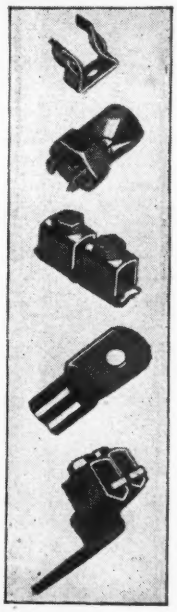


ILSCO
ELECTRICAL CONNECTORS



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No special tools.

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STRENGTH
Six times more than required.

ACCEPTANCE
Used everywhere!

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ILSCO COPPER TUBE & PRODUCTS, Inc.
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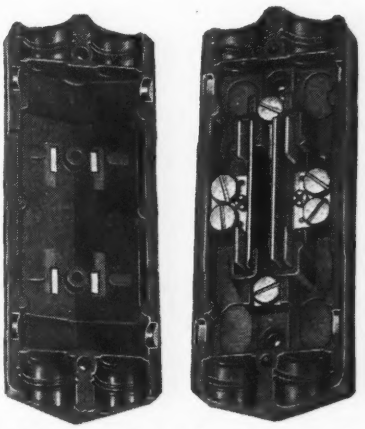
HERE'S QUICK WIRING—THAT'S GOOD WIRING!

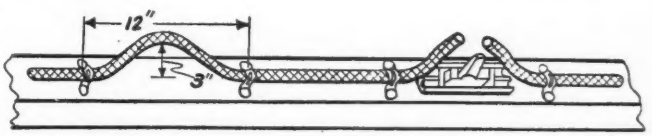


Speedy, economical wiring of farm buildings, garages, camps, and other light structures becomes an easy job when you use G-E surface wiring devices. You'll be installing good wiring, too, because these devices are offered by General Electric—the first name in electric quality.

There are seven types of G-E surface wiring devices, each one designed to give you safety, good appearance, and efficiency in every installation. All devices are $1\frac{13}{16}$ in. wide and 5 in. long for easy interchangeability. They are molded of strong, light Textolite*, and will accommodate either BraidX* or BX* in No. 12 or No. 14 sizes, two- or three-conductor.

All G-E surface wiring devices are approved by Underwriters' Laboratories, Inc.

*Trade-mark Reg. U.S. Pat. Off.



G-E Surface Wiring Devices can be installed quickly when cables are run with loops left where devices are to be located. Simply cut loops, mount devices, and make connections.

OUR NEW FOLDER lists 20 big advantages of G-E surface wiring devices, shows wiring diagrams for many types of installations, contains much useful information. Ask your G-E Merchandise Distributor for copies, or write to Section D22-128, Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Connecticut.

wiring devices

GENERAL ELECTRIC

The NEW
Guth PFC 100
U.S. Pat. Nos. 127394 and 126894 Others Pending
REDUCES GLARE...
IMPROVES QUALITY OF
FLUORESCENT LIGHTING
GUTH PFC 100's are Plastic Fluorescent Diffusers that snap on or off the tube easily — quickly. They diffuse the light from open type luminaires, shield the lamps, and reduce brightness and glare — all more efficiently than glass panels.
Sturdily constructed of durable white plastic, they maintain their shape and beautiful, modern styling.
Every user of open fluorescent installations is a customer. Available now — write today!
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Guth

...HELPS CLEAN UP BRUSH TROUBLES

Let Speer's brush-matching service cut brush renewal and maintenance costs for you . . . clean up the causes of poor commutation.

That way you're *doubly* assured of getting improved commutation and peak performance because Speer matches brushes to your motors and generators *two* ways — mechanically *and* electrically. Speer has specialized in this *two-way* matching of brushes for nearly half a century. From the all-inclusive Speer line of standard and special carbon, graphite, electrographite, and metal-graphite brushes, Speer can supply the grades best suited to the characteristics and service conditions of *your* machines.

So for utmost freedom from such brush troubles as burning, sparking, overheating, and excessive wear and energy losses —for brushes perfectly matched to your machines—call on Speer. Write for Brush Data Forms.

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SPEER
CARBON COMPANY
ST. MARYS, PA.

852

Harry J. Kahn has opened a manufacturer's sales agency at 9 South Clinton Street, Chicago, Ill. He will represent the Diamond Wire & Cable Co., the L. D. Kichler Company and the Metropolitan Device Corporation in the Northern Indiana, Illinois, Wisconsin, Iowa and Nebraska territory. Mr. Kahn was formerly sales manager of M. B. Austin Company.

•

Merit Coil & Transformer Corporation of Chicago has started construction on a large addition to the main plant at 4427 North Clark St. Mr. Koch, the president, states that the new addition, scheduled for completion early in 1947, will approximately double present capacity of the main plant.

•

Cutler-Hammer, Inc., Milwaukee, Wis. has announced the appointment of J. P. Simon as manager of the Philadelphia district office. He will also have supervision of the company's branch offices in Baltimore, Md., Washington, D. C. and York, Pa.

•

F. E. Bush and Don C. Thomson have been assigned to the Cincinnati branch office of the **BullDog Electric Products Co.,** Detroit, as field engineers. E. L. Krauss has been appointed field engineer in the Washington, D. C. office.

•

Martin Kellner, formerly sales promotion manager, has been appointed sales and advertising manager of the **Brown-Brockmeyer Co.,** of Dayton, Ohio. Prior to assuming his duties at the home office, Mr. Kellner acted as district representative in the Michigan territory.

•

William E. Hopper, Jr. will join **Hopper & McCoy,** Atlanta manufacturers agents, soon after January 1. He will travel the western part of the territory.

•

Henry F. Daley has been named district application engineer in the Atlantic District of the **B. F. Sturtevant Company Division** of the **Westinghouse Electric Corp.,** Philadelphia, Pa.

•

Thermador Electrical Manufacturing Company of Los Angeles, announces the purchase of Rotom Manufacturing Company of Alhambra, Calif.

•

Progress Manufacturing Company, Inc., Philadelphia, has announced the appointment of Edward K. Raker to handle advertising, sales promotion and sales.

4 Helpful McGRAW-HILL Books

CONTROLLERS FOR ELECTRIC MOTORS

By Henry Duvall James, Consulting Engineer, and **Lewis Edwin Markle,** Design Engineer. 324 *pages,* 6½ *x* 9¾, 276 *figures,* 6 *tables.* $4.00.

A manual on all types of commercial motor controls, describing their construction, performance, and operation, and giving pointers on maintenance, for operating men, application engineers, and purchasers of controls. Gives practical information on the safe and efficient control of motors, including explanations and diagrams on electronic tube control, arc rupturing, operation of Amplidyne, etc.

REPAIR SHOP DIAGRAMS

By Daniel H. Braymer, Late Editorial Director, *Industrial Engineer,* and **A. C. Roe,** Manufacturing Engineer, Manufacturing and Repair Department, Westinghouse Electric Corporation. *Second edition.* 387 *pages,* 182 *figures,* 52 *tables,* 74 *charts.* $3.50.

A practical, step-by-step guide for repair men and armature winders on the laying out of coils for induction motor windings and connecting the ends of the groups of these coils in proper sequence of phase and pole groups for different types of windings used in motors of from 2-24 poles, 2- and 3-phase. The information presented can also be used when reconnecting the coil groups to satisfy changes in voltage, etc.

AMERICAN ELECTRICIANS' HANDBOOK

By Terrell Croft, revised by **Clifford C. Carr,** Head of Electrical Department, Pratt Institute. Fifth Edition. 1600 *pages,* 5 *x* 7½, 1177 *illustrations,* $5.00.

This book is packed with the facts which every man engaged in electrical work needs to have constantly at hand. It furnishes specific instructions for remedying the troubles of electrical equipment as well as clear explanations of the fundamentals of electricity. Hundreds of pointers are given which will help you select, install, operate and maintain many types of electrical equipment more efficiently.

ELECTRICAL DRAFTING

Applied to Circuits and Wiring

By D. Walter Van Gieson, Assistant Electrical Engineer, Board of Transportation, City of New York. 140 *pages,* 5¾ x 8¾, 80 *illustrations.* $1.50.

An exposition of tested drafting methods as applied to circuits and wiring, presented as a series of illustrated discussions, starting with the systematic circuit diagram and developing the detailed wiring plan for several typical cases, and correlating conduit and equipment location plans. Special attention has been given to recent advances in the field of electrical drafting.

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- ☐ Croft—American Electricians' Handbook, $5.00.
- ☐ Van Gieson—Electrical Drafting, $1.50.

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Most electricians know that Gold Seal sticks tighter anywhere because there's more lasting tackiness in the friction compound – more tensile strength in the fabric. Gold Seal Tape won't dry out or smear in any weather – won't ravel or peel. It's laboratory-tested at every step, and it comes to you factory-fresh, cellophane wrapped and boxed. If you don't already use Gold Seal Tape – try a roll! Jenkins Bros., Rubber Division, 80 White Street, New York 13.

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FRICTION and RUBBER TAPES

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For a Weatherproof Socket that will stand up under the worst conditions use this socket. A trial order will convince you that it the best ever made.

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IMPACT RESISTING
BAKELITE
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LONGER LIFE
LESS REPLACEMENTS

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PARKERSBURG, W. VA.

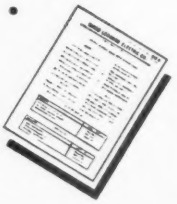
SMALL MOTOR DRIVE FOR RHEOSTAT ASSEMBLIES

• Bulletin 60 Motor Drive offers the ideal means for remote control of single or multi-plate Rheostat Assemblies. It is built on a 13" diameter steel plate for operation of Rheostats up to three plates and is available with either series or shunt motors for 115 or 230 volt operation.

features

1. All parts immediately accessible by removal of dust-tight cover.
2. Precision type snap action adjustable limit switches.
3. Motor with heavy duty gear box protected by slip-clutch.
4. Cast mounting base for motor, gears, limit switches and drive shaft maintains allignment.

Send for Bulletin 60A which gives complete information and prices on the Ward Leonard Small Motor Drive for Rheostats.



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RELAYS • RESISTORS • RHEOSTATS
Electric control devices since 1892

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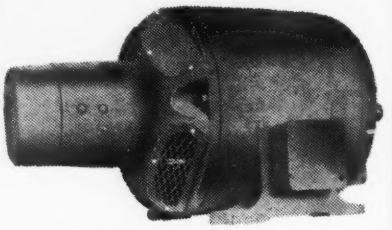
KATOLIGHT PLANTS and GENERATORS

Furnish same kind of current as city highlines for operating standard A.C. appliances and radios. For standby or continuous service.



GOOD DELIVERY ON D. C. MOTORS
Available in ¼, ⅓, and ½ h.p. all steel construction, high efficiency. Suitable for vertical or horizontal mounting.

During the past few years, we have developed a lot of "know-how." Give us a chance on your special requirements. Have facilities for building special motors and generators.

Manufacturers of A.C. and D.C. Generators, Rotary Converters, Motor-Generators, Frequency Changers, Gas-Engine Driven Battery Chargers, High Frequency Generators, etc.

KATO ENGINEERING COMPANY
MANKATO MINNESOTA

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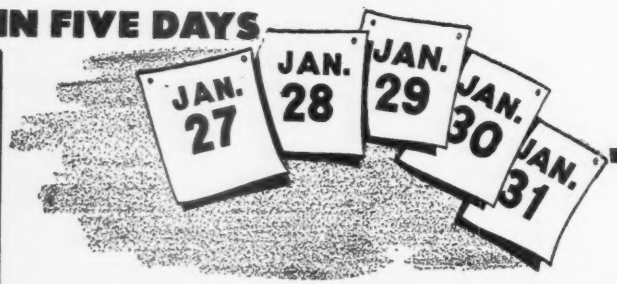

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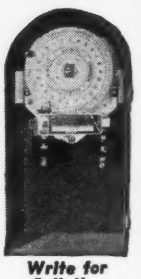

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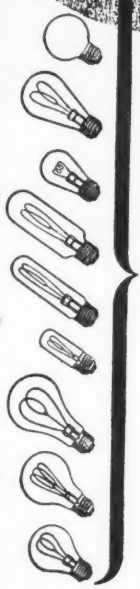

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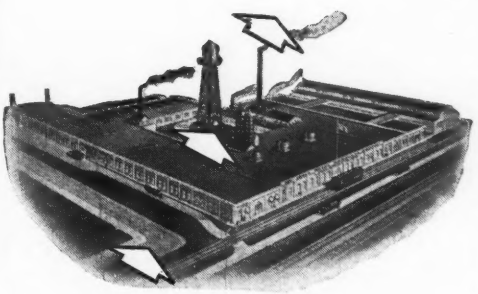

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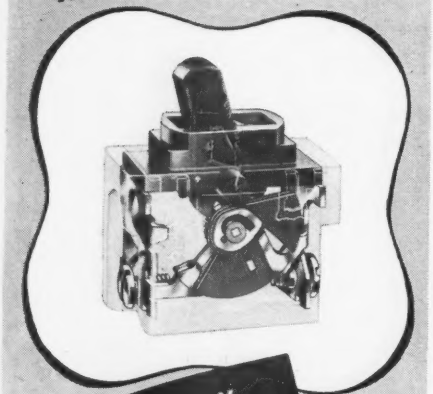

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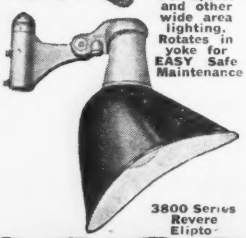

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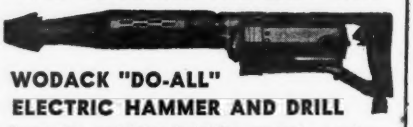

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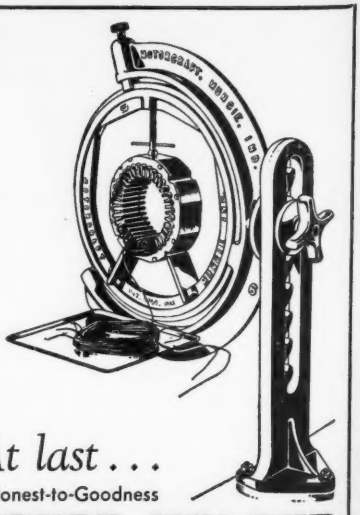

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Of Electrical Contracting, published monthly at Albany, N. Y., for October 1, 1946.
State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared J. A. Gerardi, who, having been duly sworn according to law, deposes and says that he is the Secretary of the McGraw-Hill Publishing Company, Inc., publishers of Electrical Contracting, and that the following is, to the best of his knowledge and belief a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, to wit:

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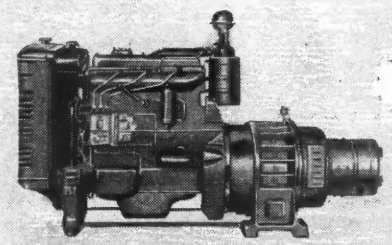

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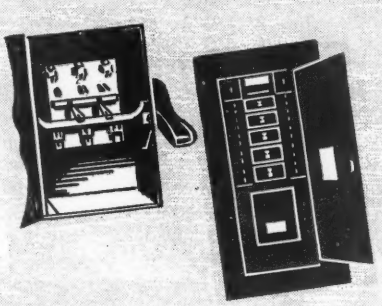

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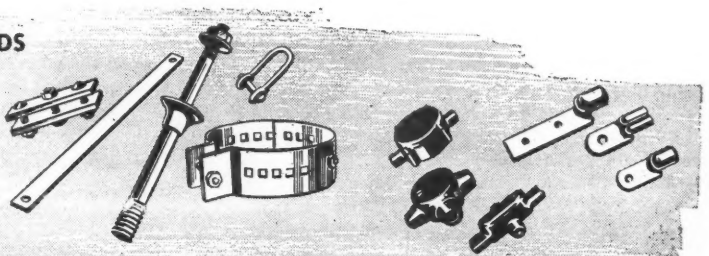

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★ These companies have supplied additional buying information on their products in the 1946 edition of the Electrical Buyers' Reference

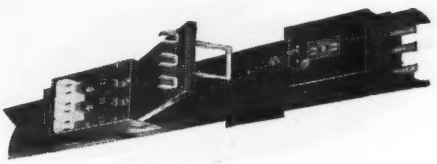
"Square D Plug-in Duct

"Highly Satisfactory to Maytag"

says **A. B. SHEPHERD**
ELECTRICAL ENGINEER
The Maytag Company

"After considering every make of this type of distribution equipment we purchased Square D Duct because we liked the construction features of the round bus, the flexible bus couplings which absorb expansion and vibration, the relative simplicity of assembly, and the rugged construction which reduces maintenance. These features (together with the service reputation that the Square D Company has acquired and maintained through our use of Square D motor starters, safety switches, relays, etc.), prevailed when we decided to purchase Square D Plug-In Duct."

A. B. SHEPHERD



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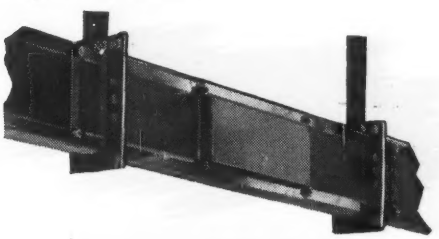
Provides Flexibility in Shop Layout

Permits plugging in machines where and when you want them. Units are easily attached and disconnected. 100% salvage for re-use. Available in 225, 400, 600, 800 and 1000 ampere capacities.



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Runs Cool—with Low Voltage Drop

Temperature rise 50% lower than for other totally-enclosed busses of equal copper cross-section and rating. Balanced voltage drop of only 1.8 volts per 100 feet of 3-phase circuit.

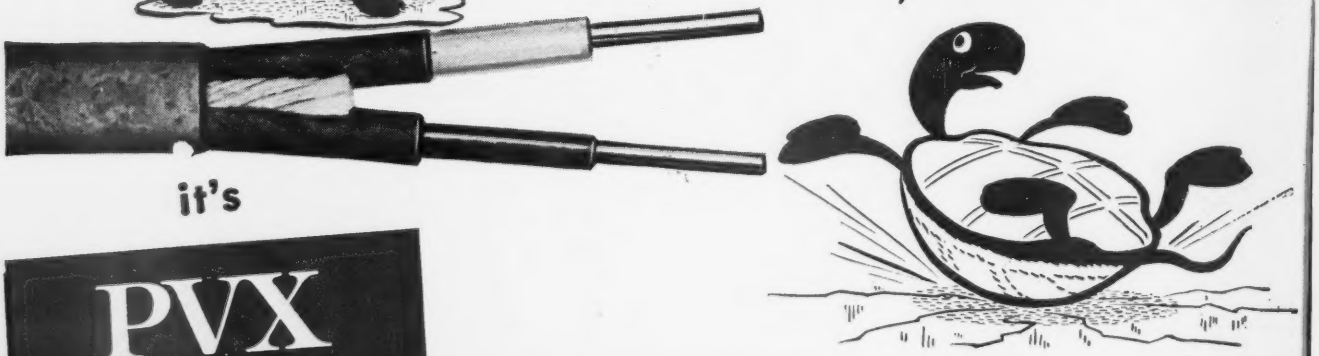
SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

Tough

Moisture Resistant

Smooth, Hard Finish



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The New Non-metallic Sheathed Cable for Residential and Farm Wiring.

Tough. Moisture resistant. Smooth, hard finish. Those words accurately describe three important features of PVX non-metallic cable that mean a lot to users.

Take toughness. From the mechanically and dielectrically strong thermoplastic insulation of the Type T conductors right through every component part — improved crushed-paper armor, waterproof jute fillers, over-all braid — PVX cable is constructed to give long, efficient service without pampering or special care. Treat it rough if you have to. PVX can take it.

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Not to mention the finish. A smooth, hard finish provides a double-barreled advantage in PVX. On the thermoplastic insulation it means that no protecting braid is required, thus extra weight is eliminated. On the over-all braid it means that there is no marking or tacking to soil hands and walls and hamper installation.

What else? Just a few things like easy stripping, small over-all diameter, light weight, and Underwriters' Laboratories' approval for 60 C operation. They are important features, too.

If you would like to know more about this versatile cable, why not ask your G-E Merchandise Distributor, or write to Section W18-128, Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Conn.

CABLE DIMENSIONS

No. 14/2 PVX Non-metallic Sheathed cable
Type T Conductor — 0.131 inches
Over-all Dimensions — 0.34 x 0.46 inches
Weight per M Feet — 77 pounds

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